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THE

FOUNDRY TRADE JOURNAL

AND PATTERN-MAKER.

Vol. 21. No. 206. FEBRUARY 1919. Price SIXPENCE Net.

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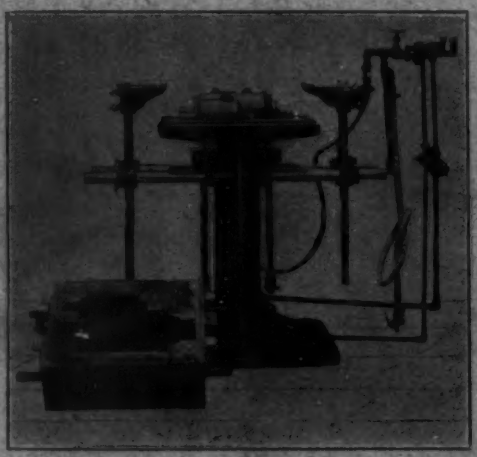

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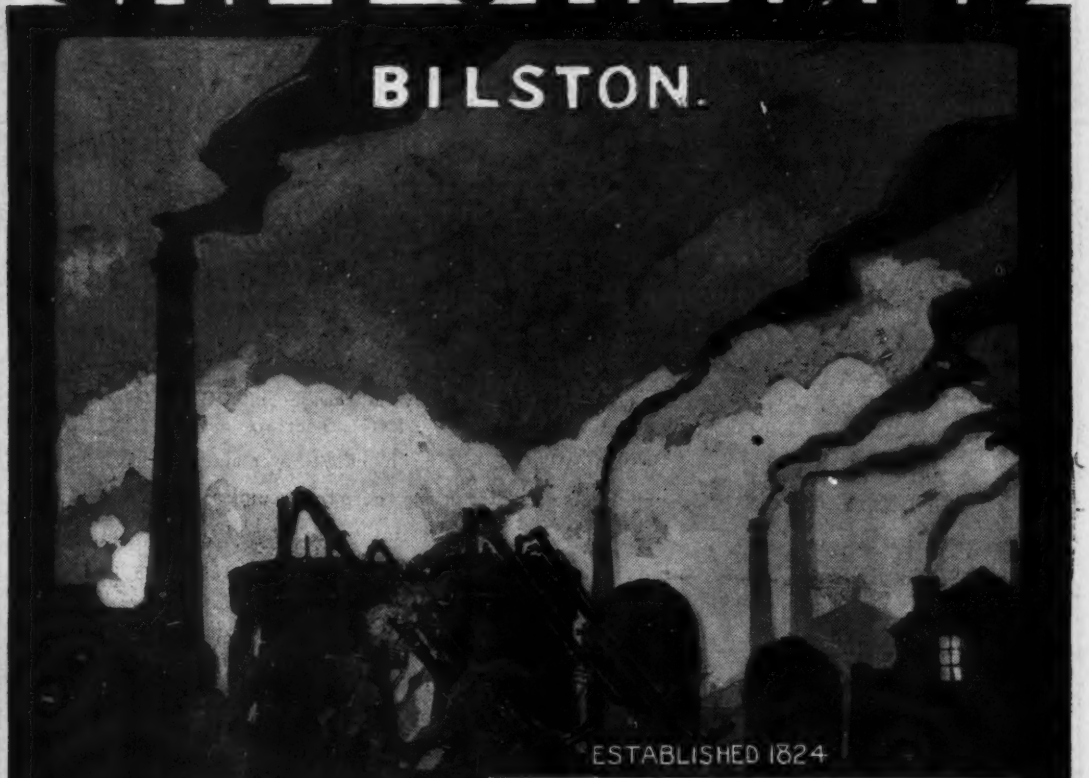

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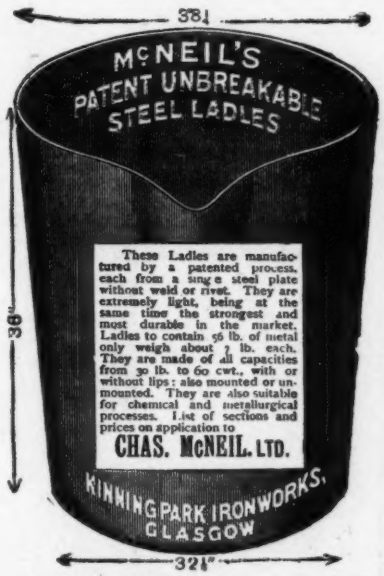
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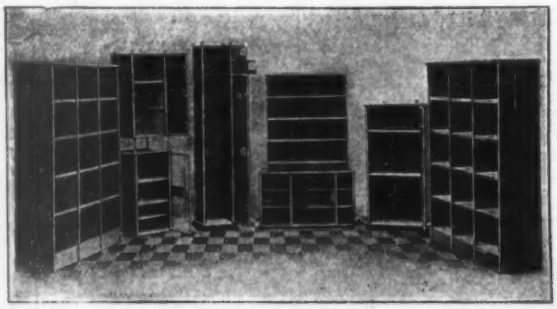

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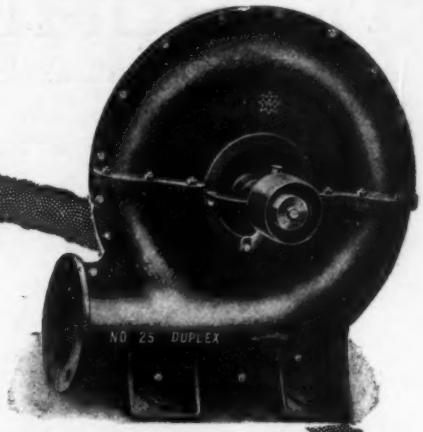

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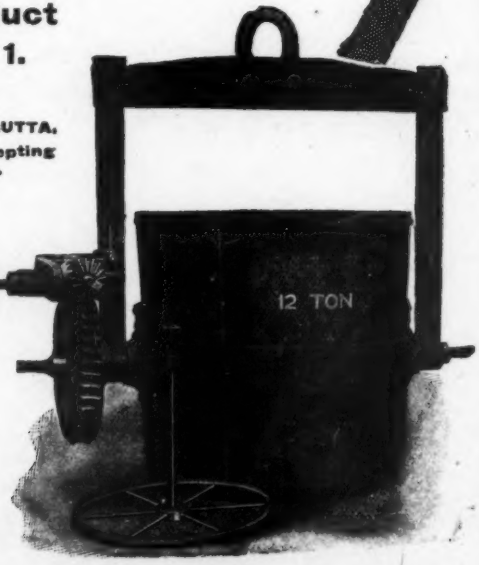

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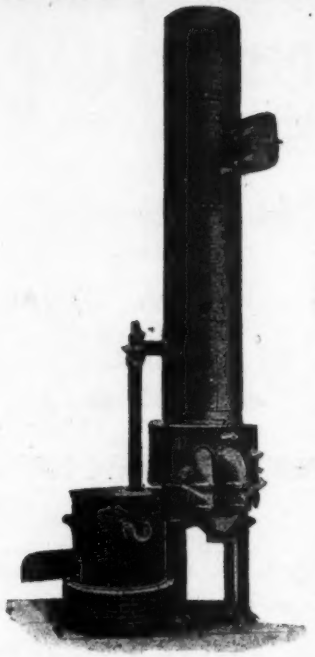

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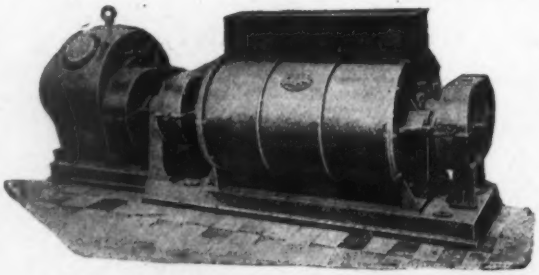

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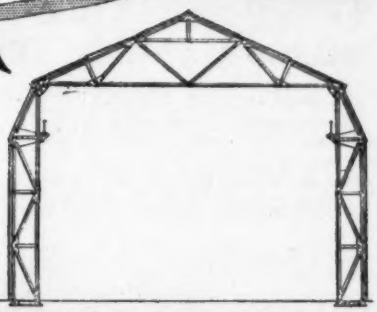

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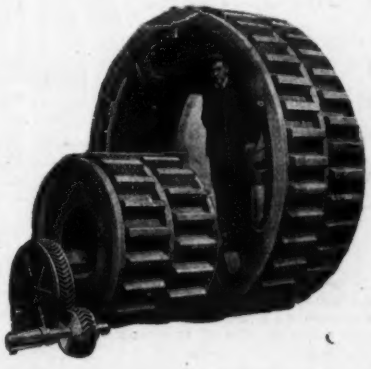

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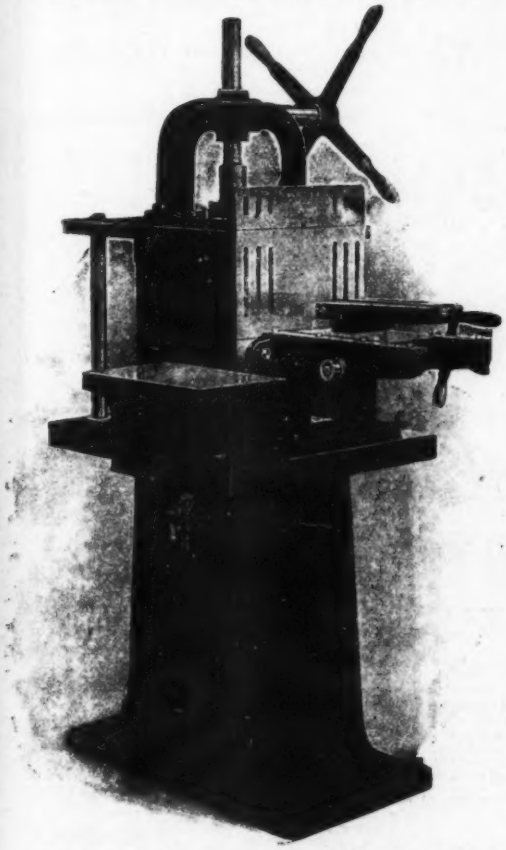

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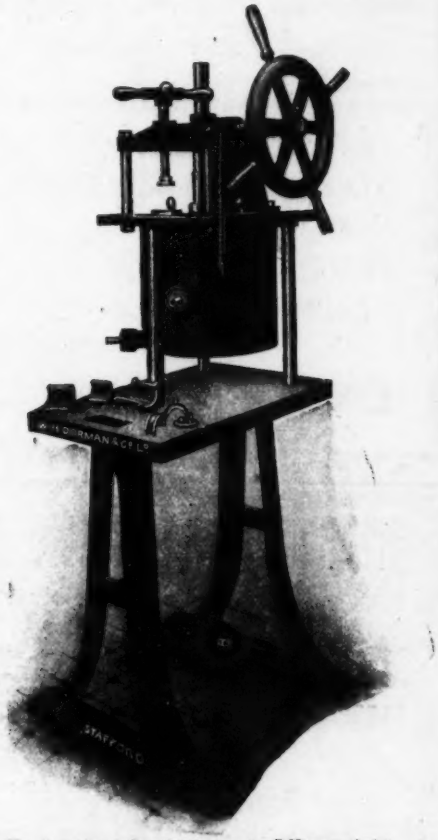

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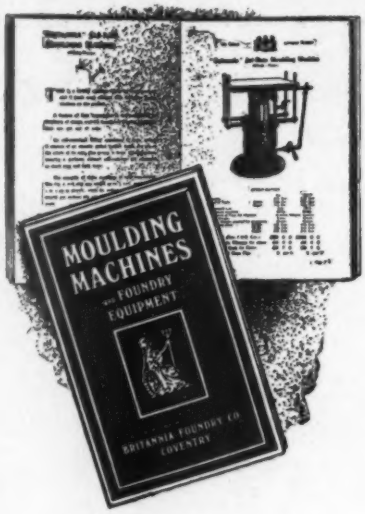

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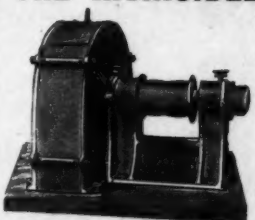

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AND PATTERN MAKER.

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FEBRUARY 21.

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British Foundrymen's Association: Birmingham Branch.—"The Foundry Service from an Engineering Point of View," by A. Borriman.

British Foundrymen's Association: Newcastle Branch.—Paper and discussion.

FEBRUARY 28.

British Foundrymen's Association: Sheffield Branch.—"Refractory Materials," by Prof. Boswell (Liverpool University).

NOTES AND COMMENTS.

British Industrial "Safety First" Association.

Our attention has been called to the activities of this Association, which was established in 1918, with the Rt. Hon. Lord Leverhulme as president, and temporary offices at 31, Westminster Broadway, S.W.1. As an evidence of the necessity which exists for immediate action, the latest published returns show that, in 1914, 969 persons were killed, and 147,045 were injured by accidents in workshops and factories alone, a large proportion of which would, undoubtedly, have been prevented had those who became casualties been educated in matters pertaining to their own safety. Millions of pounds paid in compensation, and huge sums of money lost to workers as wages, might have been saved and utilised to better advantage, and untold suffering have been obviated.

Many of the largest firms and Trade Unions in the country are actively supporting the movement, and it is hoped to proceed at once with the preparation of "Safety" notices and literature specially suited for individual industries, which will be supplied free to the firms who become members of the Association. The experience of those firms, both in this country and in America, which have undertaken a scientific "Safety First" campaign proves that, from the financial standpoint alone, many hundreds of thousands of pounds are readily saved. Under the conditions of industrial pressure, which are likely to prevail during the next few years, there will probably be a tendency to disregard many minor precautions for safety; but careful attention to the subject will show that such a policy is a short-sighted and costly one.

The Association proposes to advocate and facilitate the formation in each industry, as well as in each firm in such industry, of a "Safety First" Committee, comprising representatives of employers and employees, to investigate the causes of accidents peculiar to the individual industry, and to discover and apply effective measures of prevention. To conduct an intensive educational "Safety First" campaign among employers and workpeople, to include the issue, for exhibition in factories, workshops, etc., of pamphlets, posters, diagrams, tersely worded phrases of admonition and warning, all designed to illustrate the known causes of preventable accidents, and to indicate how to avoid them. To give the widest publicity to accident prevention methods in the press, and through other recognised channels. To organise "Safety First" meetings in industrial circles, and conferences for the discussion of all phases of the movement. To offer awards, diplomas, etc., for acts of conspicuous merit performed in preventing accidents. To place the services of "Safety First" specialists and lecturers at the disposal of members of the Association. To establish museums for the exhibition of practical "Safety First" appliances, devices and safeguards. To form a library of works, reports and statistics, relating to "Safety First," together with a collection of photographs, cinema films, and lantern slides, all of which will be available to members of the Association.

In bringing employers and workpeople together in closer co-operation and intimacy whilst pursuing the humane task of accident prevention, feelings of mutual confidence and esteem should develop; a national asset would thereby be created and become a factor of first magnitude in the work of industrial reconstruction.

Revised American Steel Specifications.

As a result of a petition presented by the Steel Founders' Society of America (representing 176 steel foundries) important concessions have recently been made by the United States War Department, which will materially expedite manufacture and considerably increase the output. Owing to the sulphur content of the coke which many converter foundries have been obliged to use, they had found it impossible to keep down the sulphur content of steel castings to the specified maximum limit of 0.07 per cent. This limit has now been raised to 0.08 per cent. for soft and medium steels, provided C does not exceed 0.35 per cent. and P 0.06 per cent. (as against 0.05 per cent. in the old specification). At the same time the mechanical tests have also been revised (the tests in the old specifications being shown in brackets) as under: —*No.* 1 (*Soft*) *Steel*:—Tensile strength 60,000 lbs. per sq. in. (same as before), elastic limit 27,000 lbs. (25,000 lbs.), elongation 22 per cent. (16 per cent.), contraction of area 30 per cent. (24 per cent.).—*No.* 2 (*Medium*) *Steel*:—Tensile strength 70,000 lbs. (75,000 lbs.), elastic limit 32,500 lbs. (35,000 lbs.), elongation 18 per cent. (15 per cent.), contraction 25 per cent. (20 per cent.).—*No.* 3 (*Hard*) *Steel*:—80,000 lbs. (85,000 lbs.) tensile strength, elastic limit 42,500 lbs. (45,000 lbs.), elongation 15 per cent. (12 per cent.), contraction 20 per cent. (18 per cent.). For No. 3 steel, however, the maximum limits of sulphur (0.07 per cent.) and phosphorus (0.05 per cent.) are to remain as before.

Industrial Fatigue Research Board.

A Research Board has been appointed by the Department of Scientific and Industrial Research and the Medical Research Committee jointly to consider and investigate the relations of hours of labour and of other conditions of employment, including methods of work, to the production of fatigue, having regard both to industrial efficiency and to the preservation of health among the workers. The duty of the Board will be to initiate, organise and promote by research, grants, or otherwise, investigations in different industries with a view to finding the most favourable hours of labour, spells of work, rest pauses and other conditions applicable to the various processes according to the nature of the work and its demands on the worker. For these investigations the Board look forward to receiving the help of employers and workmen in the industries which are studied, and in appropriate cases representatives of both will be invited to serve as temporary members of the Board. The chairman of the Board is Professor C. S. Sherrington, Sc.D., F.R.S. The Board will be glad to receive suggestions as to any problems of the kind described. All communications should be addressed to the Secretary, Industrial Fatigue Research Board, 15, Great George Street, Westminster, S.W.1.

Molybdenum in Steel Manufacture.

According to a Paper by Mr. R. M. Keeney, ferro-molybdenum is added to steel as a fixed addition, nearly all of the molybdenum remaining in the steel. It is supposed to give the steel properties similar to those of tungsten steel, but only one-third to one-half as much molybdenum is necessary; that is, where regular high-speed steel contains 18 per cent. tungsten, 6 to 9 per cent. of molybdenum may be substituted. However, it gives these properties only when the addition is properly made and proper heat treatment follows. The regulation of these factors caused so much trouble and expense that, in the United States, the manufacture of molybdenum high-speed tool steels has been practically discontinued for several years. It is used for this purpose in other countries, however, to a considerable extent. At the present time it is mainly employed in tool steel as an auxiliary rather than as a major constituent. Various reasons have been assigned for the discontinuance of the use of molybdenum. Taylor found that molybdenum in rapid steels caused irregular performance; that steels of the same composition, and having had seemingly the same treatment, gave large variations in their maximum cutting speeds. One manufacturer has stated that the ingots crack in forging, the tools crack on quenching and molybdenum appears to volatilise from the steel when heated; the latter might be due to the production of molybdenum oxide, which is much more volatile than the metal itself. When small quantities of molybdenum, say 0.25 per cent., are added, the elongation and elastic limit of the steel are greatly increased. When molybdenum is combined with nickel, the resistance to shock is increased without diminishing the elongation.

Core-Making by Blind Soldiers.

The United States Government has taken up the question, in consultation with the National Founders' Association, of the employment in foundries of men who return blind from the war. An experiment made with a blind man at Baltimore inspires hope that success may be attained in teaching the blind how to make cores, although it is believed that some special devices may have to be perfected before sightless men can reach a production basis. Among others, A. B. Segur, industrial engineer, Conway Building, Chicago, of the Red Cross Institute for the Blind is interested in the work. Officials of the National Founders' Association believe that the project will be successful, although some foundrymen are sceptical. Several Chicago foundries, will be visited in the course of the investigation

Co-operation in Engineering and Allied Trades.

During the period of transition from the manufacture of war material to ordinary trade, some difficulty may be experienced by firms having more orders on their books than they can readily deal with, whilst there will be other firms having manufacturing facilities without orders to execute. In the national interests, it is essential that firms in these two categories should be brought into intimate touch as rapidly as possible. With this object in view, manufacturers in the engineering and allied trades who need the assistance of sub-contractors, and who meet with difficulty in finding suitable firms to undertake their sub-contracts, are requested to communicate with the Superintendent Engineer of the Ministry of Munitions in the area concerned. Similarly, manufacturers having capacity available with the necessary labour should notify the Superintendent Engineer of their area. The Superintendent Engineers will give every possible assistance to manufacturers in overcoming difficulties which may arise during the transition from war to peace manufacture. The names of these officials and their addresses in different areas are as follows:—Mr. G. H. Clay, Pearl Buildings, Northumberland Street, Newcastle-on-Tyne; Mr. H. C. Buckmaster, 70, Spring Gardens, Manchester; Mr. H. C. M. Austen, Quebec Chambers, Quebec Street, Leeds; Mr. A. A. Rowse, 111, New Street, Birmingham; Mr. G. S. Knocker, 91, Queen's Walk, Nottingham; Mr. Selwyn Grant, 3, Unity Street, College Green, Bristol; Lieut. Moberly, Room 114, Charing Cross Buildings, Embankment, W.C.2; Mr. G. Davidson, 90, Princes Street, Edinburgh; Mr. W. D. Kirkwood, 39, Elmbank Crescent, Glasgow; Capt. C. Ablett, 32, Nassau Street, Dublin; Mr. A. W. Brown, Coates Buildings, Castle Street, Belfast.

Manufacture of Steel Castings by Various Processes.*

By David D. MacGuffie.

The following Paper touches on the crucible, Tropenas, Stock oil-fired converter, and electric-furnace processes. The crucible process will be considered first as it is an ideal plant with which to learn the art of steel-making and casting, there being so small a body of steel, easy to handle and control as far as the mixture is concerned. Whether the fuel be coke, oil or gas does not alter the manufacture.

Crucible Process.

An ideal crucible plant to start with is a coke-fired furnace with sufficient draught to maintain the temperature of the furnace. Crucible furnaces of the usual type are made elliptical about 20 in. × 19 in. and 36 in. deep. They should be lined with a good refractory material such as firebrick; and to save brickwork it is well to have a wooden plug made slightly less than the size of the furnace and 4 ft. long, and ram good ground ganister round the plug very hard, take out the plug and dry the furnace so that the rammed ganister does not crack during the heating up.

The furnace now being ready, the next thing to consider is the type of crucible or pot to be used. The best type is a clay pot, but such pots have to be made in the foundry as they are so fragile they cannot be sent very far on transit without being broken. Various mixtures of refactory clay are used, different foundries using different ones. The various clays and mixtures are ground up to the required fineness and weighed out to suit the size of pot to be made; well mixed together in a dry state and water added to bring the mixture to the required condition. In the absence of a mixing machine, the best way is treading the mixture by the bare feet, and turn-over with a spade. This should be continued until the mixture is perfectly uniform. The clay is cut into weighed blocks, each of which should be subjected to a thorough kneading by hand till all air bubbles are expelled.

A cast-iron mould made the shape of the pot is used to form the outside shape, and has a round hole in the bottom for a plug to fit in, the plug being of such a size as to give the required thickness. The mould stands on a bottom plate with a small hole to keep the plug central. The inside of the mould and also the plug should be well oiled. The ball of clay is put in the iron mould and the plug driven into position by the aid of a mallet, the clay rising around the plug above the iron mould. The surplus is simply trimmed off and shaped at the top, the plug withdrawn, and the pot or crucible put to the required shape by hand. The drying and airing of these pots are important. As soon as a new pot is air set, it should be put in a warm place to stiffen on shelves, preferably over the top of the furnace or drying stoves. The pot is not fit for use for at least three weeks; to rush the clay pot in drying is disastrous. A good man should make 30 to 40 pots a day, and one pot should last an average of four to five heats, according to the quality of clay used. The lids and stands are made with the same material.

A good mixture for clay pots is:—50 per cent. of Derbyshire clay, 25 per cent. of Glenboig clay, 25 per cent. China clay, with a little coal dust. A plumbago pot should be made with 70 per cent. of best plumbago, 10 per cent. of Derbyshire clay, 10 per cent. China clay, 10 per cent. of Glenboig clay.

When preparing to melt, first the pots should be made red-hot in the stove before using. On the bottom bars a clay stand the size of the bottom of the pot and two inches thick is placed, and the pot on the stand. The size of furnace given will hold two small pots. The lids should be put on the pots and the fire made up, using good coke, not too large and not too small. As soon as the pots are red-hot a little silica sand is thrown in, as the hand-made pots have a vent hole at the bottom. The pot and clay stand then frit together. Charging is done with a long funnel, and for making mild steel castings, punchings or Swedish bar iron or any low-carbon steel in small pieces will do. After the pots are filled and the lids put on, the fires are coked up. As the coke burns down it should be renewed.

If the furnace is going well, in 2½ to 3 hours the charge will be melted. It must be kept at the same temperature, to insure good results, for another 30 minutes, to make what is called a "dead" melt. Small quantities of ferro-manganese and fello-silicon, according to quality, are added. Before casting the heat should be tried with the aid of a ⅜-in. iron rod, by putting it right down to the bottom of the pot for a period of ten seconds. If the rod comes out clean you have got the right casting temperature; if the steel adheres to the rod, then the metal is unfit for casting.

When ready the pot is quickly lifted out and the slag taken off; a small cover is put over the top of the pot to keep the heat in and the metal then poured as soon as possible, teeming slowly at first.

The moulding of crucible steel casting is very little different from ordinary cast-iron moulding, except that Mansfield red sand mixed with 25 per cent. silica sand is used, and risers should always be put on crucible castings where any thickness is concerned or machining. The carbon content is generally higher in crucible steel than any other, especially when using the plumbago crucible, as in the melting a certain amount of carbon is absorbed from the pot. There is always a fair amount of pipe or shrinkage under the risers. Sharp corners must be filleted to prevent any shrinkage in the sharp corners.

An ideal analysis of crucible steel for castings is carbon 0.40, silicon 0.15, manganese 0.45; sulphur and phosphorus are always fairly low.

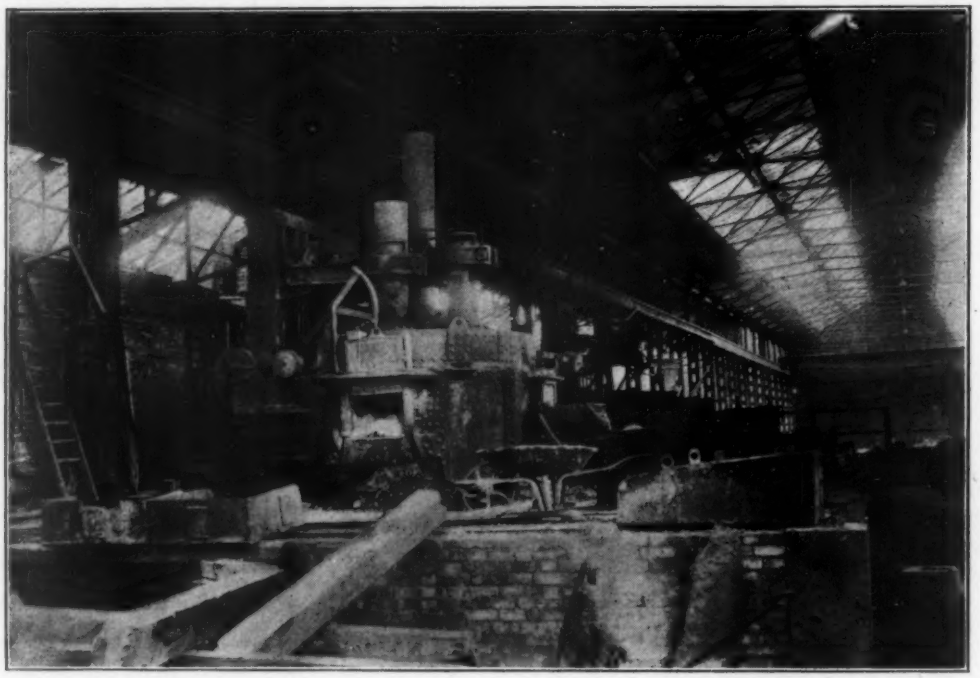
Tropenas Converter.

This process is mainly used for the manufacture of steel castings from a few pounds to about 3 to 4 tons. The converter is circular in form externally, not unlike a Bessemer converter; a steel shell in three parts comprising the mouth, body and bottom part which carries the bath. These are fastened together by means of cotter bolts.

* Read before the London Branch of the British Foundrymen's Association, November, 1918.

The converter itself is mounted on trunnions, so it can be tilted at any angle required.

The lining is usually of silica bricks, although some users try ganister; but for a surface-blown process the writer does not advise it. The silica lining, of course, implies the acid process. The bottom of the converter bath is tapered so as to expose a considerable surface of the metal to the volume of air, while still having a depth. The tuyeres are at one side of the converter at such a height that when the converter is vertical they are a little above the surface of the metal. If the metal is above the tuyeres the lining is torn to pieces by the back-wash, and also, should anything happen to the working of the converter the tuyere-box gets filled with metal. There must be sufficient metal in the converter before commencing to blow, and the converter must be at the right angle.



3-ton Heroult Electric Furnace; London Foundry Company, Brimsdown.

The tilting-gear should be motor-driven, not hand operated, unless for a very small plant. The cupola must give hot metal in the quantity required by the converter. Independent air blast for the converter is desirable. After heating up the converter to a white heat with coke and a small amount of blast, it is tilted in all kinds of positions to get it hot all over; then turned nose downwards to clean out all coke, any that sticks to the lining being raked off. The converter is then tilted to the right position to receive the molten iron from the cupola, either by teeming from a ladle or a radial spout attached to the cupola. The converter is then raised to such an angle that the air from the tuyeres plays upon the surface of the metal. When evolution of carbon monoxide becomes rapid the converter is turned a little more upright and air sent through the second row of tuyeres, so as to burn the carbon monoxide evolved to carbon dioxide within the converter, and thus increase the temperature. At this period the converter is slightly tilted again, so as to get the flame through quickly, at the same time increasing the blast, which should be about 3¼ to 4 lbs. pressure per sq. in.

The silicon flame next appears, with violent reaction and liability to loss of metal by being boiled out of the mouth of the converter. To avoid this the pressure is regulated and the converter tilted slightly. When the flame dies down a little the carbon flame begins to show very prominently, with purple streams on the outside. The flame must be watched very carefully, as the flame gradually dies away and appears to be about 6 to 12 in. from the mouth of the converter. The converter is at once brought down to clear the tuyeres and the blast shut off. The ferro silicon, ferro manganese or spiegel should be added, and if, say, carbon of 0.3 to 0.4 is required, hot molten iron from the cupola is added to recarburise. A rabble or rake is used to stir up the steel and give it a good mixing. The ladle must be red-hot if stopper poured; it is put under the converter, which is tilted very slowly till all steel is put in the ladle, at the same time adding a little aluminium in the ladle. The metal is now ready for casting.

The moulds should be thoroughly dried, cored, closed, bushed up, and set in straight lines, so the teemer can go straight ahead. The boxes should all be one height if possible, to save hoisting. The moulds are made in composition or French sand or silica sands and oils, with just sufficient clay to bind, or Yorkshire sand. All steel foundry sands should be analysed to avoid the presence of alkalies

or oxides. The chief thing to look for in steel foundry sands is high silica with sufficient alumina to bind. The writer always uses Yorkshire sand, which is an English sand mixed with other ingredients. This sand should not be used dry, but just plastic enough to hold together when squeezed. Whatever the type of mould, this sand must be rammed very hard on the face, even if the casting is very intricate.

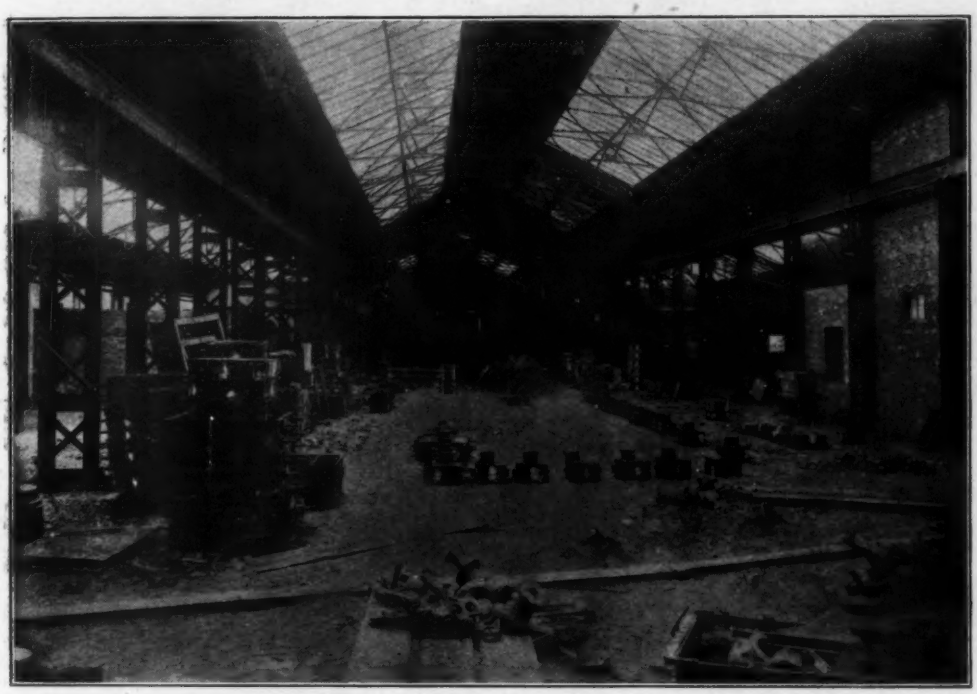
The casting should be eased anywhere it is likely to pull, by cutting away the sand. The face of the mould must be evenly rammed and rock-hard. To save dirty castings and scabs in front of the runners, a few flat-headed nails are used on the surface. When the mould is finished it should be well watered, but not slaked. No blackings or paints of any description are required with this sand. If for light castings with thin, sharp corners, the moulds should be hot. Cores also can be made of this sand let down with 25 per cent. of silica sand and mixed with any of the oil binders.

A good Tropenas plant of a one-ton capacity, with everything working as stated, and a spare converter, so repairs can be done without stopping, should turn out 14 blows a day on a working day of 10 hours, which would give 10 tons of castings per day.

Stock Oil-fired Converter.

The Stock oil-fired converter is an excellent plant for making light castings to any specification. It was invented at the time when crude petroleum was plentiful and cheap, although I believe at the present time other kinds of oils are being used in it. One of its most important features is that, owing to oil being used, no impurities are introduced into the metal during manufacture, and also no cupola is required; the steel pours very hot, dead, and with much freedom, and lends itself more readily to the teeming of light and intricate castings.

The Stock converter is lined with a 9-in. silica brick shaped to the converter, with sufficient ground ganister near the shell's side to clear any bolt or rivet head. Like all other converters, joints in the brickwork should be so close as not to admit the trowel point; for owing to the steel being so fluid it is liable to get through the brickwork. The converter is mounted on trunnions for tilting backwards and forwards, and the whole mounted on a base plate which rests on a roller path, and attached to gearing which enables the converter to be turned round to any position both for charging and melting.



View in Steel Foundry; London Foundry Company, Brimsdown.

For a 3-ton Stock converter the blast capacity is 3,000 cub. ft. per minute, from an ordinary Roots is 3,000 cub. ft. per minute, from an ordinary Roots blower. Blowing pressure varies on account of melting and blowing in the same converter; for while melting only ¼-lb. pressure is required, and when converting into steel 3½ to 4 lbs. pressure. The blast arrangements are entirely different to the ordinary side-blown and bottom-blown converter, for the blast enters by a main passage through the bottom plate, so the converter may be turned round without any interruption. The blast then passes through one of the trunnions into the blast box at the side of the converter.

As it requires to melt pig-iron by oil, burners are used which consist of fine, small tubes which are put into the tuyere holes and are removable. There is also a small pump employed to maintain

a pressure from the oil storage tank at 40 lbs. pressure, which feeds direct to the burners and is regulated by a hand valve.

Another feature of this converter is the economiser, which serves to recover waste heat arising from the combustion of oil during melting. The economiser consists of a series of ribbed cast-iron pipes of U section, through which the blast passes. The heat from the oil flame at the nose of the converter passes through an aperture into the economiser, and passes round U-shaped pipes on its journey to the converter, and what is not required passes away up a chimney stack. By this system the cold air from the blower is raised to a temperature of 800 deg. F. before passing into the converter.

The working of the converter is simple, and position the oil and blast are shut off. The "peel" is placed in position on a rest bar at the mouth of the converter, and one man and a helper proceed to charge the pig-iron, protecting the belly of the converter by laying the pig-iron in layers. Scrap steel should be placed in last, right under the oil flame at the back of the converter. The converter is then turned round with the nose pointing to the mouth of the economiser, the blower started and the oil turned on, the pressure being ¾ lb. per sq. in.

After one hour the oil and blast are shut off and the converter turned round to charging position for rabbeling to stir up the bottom of the bath that is less exposed to the heat. The converter is then turned round to melting position and the oil and blast put on for another 15 to

View in Steel Foundry; London Foundry Company, Brimsdown.

metal comes out with regular analysis, for the general run of steel castings, providing decent oil and the required hematite iron are used. The latter should have 2¼ per cent. silicon, low sulphur and phosphorus. During converting the pressure varies little, except during the silicon "boil," when it is slightly reduced to save blowing waste.

After a new converter has been lined with silica bricks a slow coke fire must be put inside for at least 12 hours. To get the converter ready for charging the oil burners are placed in position, the blower started, oil turned on, when from the heat of the lining the crude petroleum ignites. A pressure of ½ lb. to ¾ lb. is maintained for a period of 30 to 40 min., when the thermometer on the blast pipe will be seen to rise. At about 680 to 700 deg. F. the converter is ready for charging. Before turning the converter round to charging 20 min., when it is hot enough for converting. Oil and blast are shut off, the converter tilted slightly, the oil burners taken out, and the surface of the bath set so that the metal is level with the bottom of the tuyeres. A dummy plate is placed in the holes where the burners were, making the blast box airtight. The vessel is then tilted into blowing position and conversion proceeds.

Ferro-silicon of usually 12½ to 14 per cent., and spiegeleisen of 18 per cent. Mn., 14 per cent. carbon, are used, and should be got red-hot before being put into the converter. The bath should be given a good rabbeling to ensure uniformity. Here, again, stopper pouring is preferable, to keep the castings free from slag. Moulding for this process is the same as for the Tropenus or any other plant.

The Electric Furnace.

The electric furnace, owing to the fact that it involves no difficulty as regards temperature, is very adaptable for the manufacture of light intricate castings, and as it secures low sulphur and phosphorus is suitable for high-class work—that is, when using a basic furnace, for the acid type simply melts and kills the steel. Refining can be done only with dephosphorising and desulphurising slags.

The reduction of the carbon content of the bath is performed by the action of the iron ore added. The carbon is oxidised to carbon-monoxide, which can be seen passing away out of the furnace and through the opening round the electrode in the form of a brown gas, and as the carbon is reduced so the gas dies away to a pure white flame. The silicon in the bath is also oxidised to silica, which becomes part of the slag.

Moulds for Steel Casting.

A good steel casting depends first on the class of steel and next on the sand. Only a few years ago it was a very difficult matter indeed to get a good face on a steel casting, and also it was difficult to get castings thick and thin in different proportions without cracks and pulls or strains, while brackets of all description were put into the mould to hold the casting together while cooling down. I believe even to this day there are many steel foundrymen who are "bracket mad." The secret of good castings is in the sand having good refractory qualities, being high in silica to resist the temperature, having sufficient alumina to bind it, and low in alkalies. The mould should not be like a solid block of sand, but more like a riddle, only having sufficient sand to face the steel and strong enough to stand the pressure of teeming. Cores should be made like shells and not like concrete blocks, to allow the casting freedom in every direction. Heads and runners should be in fair proportion to allow the casting to cool down gradually. For instance, wheels of any description should have all arm cores made like shells and as few core irons as possible, and the latter should not be long enough to stop the casting from contracting. The writer has made pipes from 4 to 8 ft. long with flanges 1¾ in. thick and an 8-in. core, ⅜ in. thick, with Yorkshire sand, with risers on the top of the flange and not a bracket of any description on the body or flanges. When cast they were simply eased round the risers, the casting taken out of the bottom part and kept covered from any draughts or cold air; and not a crack was to be found. Wheels and loco centres, tractor wheels of the hollow spoke type, spider wheels and blank wheels were all made the same way, with freedom in every direction. A few years ago nothing but steel-moulders' composition was used, and when the moulds were painted and tarred, after being stoved, they were like concrete. Moulds for steel castings to be machined should be dried thoroughly; and although green-sand moulds are tried in various parts of the country the scrap made is excessive. The moulds should be rammed hard even on the face, so there are no soft places, and all joints should be laid down and eased wherever they are likely to crush.

Risers on steel castings are always fairly large, and want feeding. The runners require to be the same size as the nozzle or stream of steel when bottom poured.

With steel containing high silicon and low manganese one can expect "pipe" or shrinkage; at the same time, in frosty weather the castings are liable to fly just the same with high manganese, such as 1 per cent., and silicon about 0.15 per cent. Trouble can also be expected with steel containing high sulphur and phosphorus, which causes red-shortness and cold-shortness. The following analysis gives fairly good results:—Carbon, 0.25; silicon, 0.25; manganese, 0.65; sulphur, 0.018; phosphorus, 0.019. With this steel you can saw off the heads, and also, if the castings are not particular, one can despatch the castings without annealing.

High Grade Malleable Castings.

According to a Paper presented by Mr. J. G. Garrard, North-Western Malleable Iron Company, Milwaukee, Wis., to the American Foundrymen's Convention, the idea that malleable iron castings should never be made with heavy sections, as they cannot be properly annealed, is still in the minds of men who have been using malleable castings for years. Every effort should be used to correct this impression and convince them that heavy sections can be thoroughly annealed. This false idea, coupled with poor design of patterns, is the greatest difficulty the malleable foundryman has to contend with. When changing over from malleable cast-iron to steel, the steel sections are always increased and ribs eliminated for the purpose of reducing shrinkage, whereas the failure of most malleable castings can be eliminated by changing the design. Abundant evidence is available to prove that good malleable castings can be used in place of steel.

There is more or less of a trick connected with making castings with heavy sections. First, one must get the metal high enough without too great a reduction in carbon, it being a known fact that carbon oxidises much more rapidly than silicon and can be readily identified in the test piece by the short crystals. This condition with the silicon under 0.50 per cent. cannot possibly give good results. The metal, however, can be changed in the furnace with the addition of low-silicon pig-iron to increase the carbon.

Gating with heavy shrinkers and close attention to the ribs on any particular casting is very important Chills can and should be eliminated in most cases, as they do not correct the trouble, but simply drive the shrinkage from one place to another. The author's firm have experimented a great deal with their furnaces in reference to top blast, as it is his contention that excessive top blast not only causes more shrinkage, but produces unsound and weak castings.

His firm adopted a method of practically eliminating pressure on the top blast, and in doing this they do not have any trouble with high heats, as the firemen cannot force the heat to the extent of excess oxidation. The blast at the tuyures shows only two-thirds of an ounce, and the author believes this accounts for the following results:—

	First iron.		Last iron.	
Test No.	Silicon. Per cent.	Total carbon. Per cent.	Silicon. Per cent.	Total carbon. Per cent.
2	0.90	2.65	0.90	2.51
3	1.04	2.62	1.04	2.61
4	1.02	2.56	1.00	2.49
5	0.92	2.61	0.95	2.59
7	0.98	2.40	0.99	2.42

A furnace run to turn out uniform first and last iron, annealed with the use of pyrometers to insure the proper temperatures, is bound to give a tensile strength of 45,000 lbs. and over per sq. in, with an elongation of 7½ per cent. and over in 2 in. There has been a great deal of confidence placed in castings showing a deep skin. This skin is carbonless iron produced with strong packing which absorbs the carbon from the outside of the casting. Such a skin can be increased by more than one annealing, but it does not show any great advantage over the casting annealed without packing or in a straight cinder packing.

Patterns and Moulds for Engine Cylinder Castings.—I

By Joseph Horner.

In this and a succeeding article it is proposed to deal with the leading principles which control the class of work named. It seems desirable to approach the subject in this way, because many men who occupy responsible positions know very little about the nature of the double practice of both pattern-shop and foundry. Only from both aspects can the subject be dealt with satisfactorily.

Cylinders vary greatly in dimensions and in degrees of complication, and the methods that are excellently adapted to one design would be most unsatisfactory and costly if applied to those of another kind. These include complete patterns of wood or of metal, skeleton patterns, plate moulding, and the core making and setting—matters also concerned with pouring, and venting, and much beside. Every different design of cylinder gives rise to a new set of problems. Large differences in dimensions are of equal importance. The numbers off required influence methods. Green sand, dry sand, and loam moulding are all employed in cylinder making.

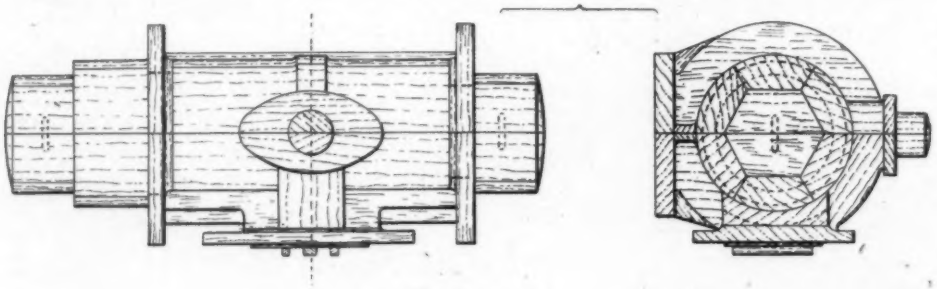


Fig. 1.

Wood Patterns.

For most large patterns made complete—that is, not swept up or strickled—the construction must be in wood. Exceptions occur even in some of those of fair size, as in standard engines where very large numbers are required. But these exceptions are not numerous. When cylinders are constructed in timber they exercise the ingenuity of the pattern-maker with a view to securing the maximum of strength and permanency of form, with the employment of the minimum of timber, and to adjust the balance of expense between moulder and core-maker. Very often wooden patterns or portions of them are cored solely or mainly in order to secure the maximum of strength, for it is evident that thin, curved and flimsy parts cast in metal cannot be so formed with safety in timber. Again, no two men are likely to adopt precisely the same methods of construction. Usually in regard to the main scheme similar methods are adopted, but not in the various details. Moreover, many patterns occupy a border line where more than one method would be legitimate and satisfactory. Yet every man's opinion differs, and also the usual practice varies in different shops. One is not right and the other wrong, but men simply hold different views, nothing more.

It is essential to draw out a cylinder casting on a shop drawing-board to full size in all its views, for otherwise errors in the corebox work will be sure to result. Facing and boring allowances must be understood, and may be added and indicated on the drawing, and the lengths of the core prints are outlined. Then dimensions are taken safely at first hand from this drawing, and subsequently the details of the pattern and corebox work are laid upon it, to be checked directly as the construction proceeds.

Fig. 1 represents a very plain typical cylinder pattern, on which the following general remarks on construction are based :—The lagging extends over all to the ends of the core prints, since there is not sufficient difference in the diameter of prints and body to require making the prints separate from the body, as there is in some classes of work. Recesses are made to receive the flanges, which may be turned on the faceplate and inserted in their recesses, or be turned up in place. If the latter method is adopted, then the flange pieces must be planed to the same thickness as the width of the recesses, and bored to the diameter of the bottom of the recesses, and either be glued in, or be screwed from the interior, or held temporarily with dogs, which will have to be shifted from flanks to circumference, or vice versâ, as the turning proceeds. Turning the flanges separately on the faceplate is least troublesome. A supplementary length is generally allowed beyond one flange for head metal, ranging from 3 in. or 4 in. to 10 in. or 12 in. long in the smallest and largest cylinders, respectively. It either runs parallel with the body of the cylinder, or it is enlarged towards the print end. From this stage an almost infinite number of variations occur in cylinder work, in the forms of steam chests of valve faces, and passages.

The passage block, steam chest face, and valve face in a common cylinder are, when practicable, moulded with the valve face downwards. If the steam chest itself is cast with the cylinder, its interior may generally deliver itself. But not infrequently it is cored out, and then the passage cores may be inserted in print impressions in it, or be rammed in one with it, so avoiding the trouble and risk of fitting and securing each passage core into its own separate print impression.

The passage block (Fig. 2) is fitted by planing,

assisted by the gouge, to the body of the cylinder, and is screwed permanently to it, care being taken to check the parallelism of its face with the pattern joint by means of straightedge and rule or calipers. The portion that lies beyond the face is cut convex, concentric with the cylinder bore and with the passages. The steam chest flange and the valve facing are then prepared and dowelled on the block, taking care to have these parallel and square with the edges and ends of the cylinder. On the facing, the prints for the steam and exhaust are nailed, screwed, or dowelled square across, and at very exact positions from the centre and from each other, not forgetting the allowances for tooling the cut-off edges.

The exhaust, in ordinary cylinders like Fig. 1, is usually fitted round the body. It is of a D-shape in transverse section, or approximately so. Fig. 1 shows its fitting, in which the timber shading, as in other parts, renders detail of direction of grain, etc., apparent without special remark.

Feet or flanges are cast on most cylinders for bolting them to their beds or framings. Generally these come at right angles with the valve faces, or else on the opposite side. If at right angles, and if the valve face is moulded in the bottom, the feet are made fast to the pattern sides. In cases where they have to come in the bottom they must be left loosely screwed from the inside of the pattern, or be retained temporarily with skewers. The sand above, that is, between their back face and the cylinder body, is then carried on drawback plates, or alternatively cores may be used, for which prints would have to be provided.

This is a plain general statement of the work for

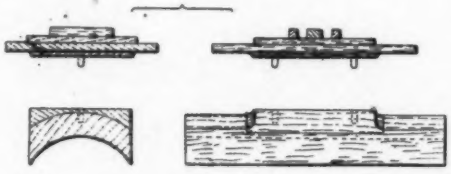


Fig. 2.

a single cylinder. More difficult ones are the jacketed cylinders, and those with recessed steam chests, etc.

Metal Patterns.

The importance and value of these increase constantly. The selection of metal in preference to wood is almost wholly determined by numbers of castings off and dimensions. The metal pattern is only justified (apart from extreme flimsiness) when large numbers of moulds, say hundreds or thousands, are required and when dimensions are not excessive. But since moulding machines have grown to very large capacities, patterns are made much larger in metal than would have been formerly justified when they were handled only in ordinary hand-rammed moulds. Metal patterns are costly, and in most cases a pattern of wood must be constructed in the first place from which to obtain that of metal. What renders them expensive is the tooling which has generally to be done. Unless shapes are so simple that they can be dealt with in the lathe, planer, or other machine tools, much of the finish must be imparted with the file, which is tedious. But the expense is more than justified, and it is necessary when work is highly repetitive. The cost of patterns becomes a mere trifle then by comparison with the gains in accuracy, permanence of form, and uniformity in dimensions of the later as well as of the earlier castings moulded.

The use of bottom boards (Fig. 3) and the plate moulding of wood patterns (Fig. 4), usually precedes the employment of metal patterns. A great deal of this has always been done apart from the aid of machines, which, applied to this kind of work, is of much more recent date. The bottom or joint board (Fig. 3) receives a half pattern, and simply forms the joint face, and saves the time of making a false mould to get that face, to be knocked out afterwards. Incidentally it facilitates the setting of the box over the pattern, since the box pins enter holes in the bottom board. After the drag part has been rammed on the board, the latter is put aside, and takes no further part in the moulding, the top part being rammed on the bottom after turning over. When a pattern is mounted on opposite sides of a wooden plate, as at Fig. 4, the joint faces of the mould are rammed on opposite sides of the plate, to which the pattern halves are either permanently attached or are dowelled, the plate and pattern being turned over. The pins of the drag part pass through the plate

Fig. 3.

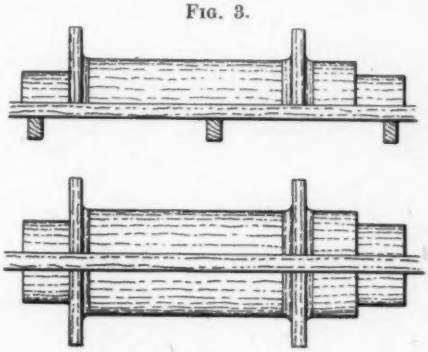


Fig. 4.

and into the holes in the top part, the two parts being cottered together.

Fig. 5 shows the way in which metal patterns are moulded in halves on a plate. They are prepared apart from the plate as though for ordinary moulding, and screwing holes are drilled through. Holes in the plate are marked and drilled to correspond, and then the pattern halves are screwed through it, or riveted. Head metal and fitted parts are not indicated. The details of the fittings of steam-chest feet, branches, etc., are those to be described in connection with later specific examples. The drawing is shown as for plate moulding. For machine moulding the plate may have trunnions or other fittings, depending on the machine used. Only the smallest cylinders would be made solidly in metal. Those of moderate and larger dimensions are lightened out with cores as indicated in the right hand, Fig. 5.

The general construction and the methods of making cylinders are governed by the degrees of accuracy required, the permanence of forms, uniformity in dimensions, and numbers required off. In the last the others are usually included, so that numbers are, more than any single condition, the dominant factor.

The degree of accuracy desired is one of the primary matters which is reflected in a dozen details of the pattern work and moulds. It includes the lagging-up of patterns in wood, and the use of metal in preference to wood; but there are others also, as rapping, delivery, shrinkages, plating, machine moulding, besides such things as the coincidence of cores and their prints, and so on.

Rapping and delivery are the principal sources of variation in the sizes and outlines of castings that are made from the same pattern. The risks increase with the depth of moulds having vertical sides, as those of feet and valve facings. A semi-circular section is the most favourable to delivery, but vertical sides must have taper or draught, and must be rapped to loosen them from the pressure of the sand before they can be withdrawn. The degree or amount of the rapping will vary, as also will the unequal pulling of the sides during withdrawal. If the sand fractures, the mending and repair of the broken and cracked portions tends to increase the amount of inaccuracy. These risks vary with depths and shapes, and with the character of the pattern itself. The larger it is, the deeper and more nearly vertical its sides are; and the less carefully it has been constructed and finished, the greater are the risks of distortion in the mould. In some kinds of work the matter is of relatively small importance, but it is serious in cylinders where much tooling has to be done, and especially when, instead of being lined-out, they have to be mounted in box-like fixtures to be tooled, which practice increases.

When to these sources of error is added the variable amounts of shrinkage which are observable in metal of various grades poured into similar moulds, cumulative errors result. Shrinkage variations are produced not only by differences in metal mixtures, but also by differences in pouring temperatures, whether hotter or cooler, and whether the mould is relieved of strain by risers, and so on. Unequal shrinkages are not only of serious import because they cause variations in the dimensions of cylinder castings which should be alike, but they also intensify the shrinkage strains, which are a source of distortion and even of danger. They are, too, a result of bad proportioning, which is a problem in design, but evils also very frequently due to carelessness on the part of the moulder, who may do much to counteract the effects of a bad design.

Core Boxes.

The cores are made in different ways according to their shapes, and also to the practice of shops. The centre core is generally swept up against the edge of a board, but in most cases, in standardised work, it is rammed in a box. The passage cores are generally distinct from each other, but often also they are rammed in one along with a steam-chest core. They may abut only against the round body of the main core, or they sometimes enter into print impressions made there if the design permits of their insertion.

The general shapes of steam passage and exhaust boxes are nearly all covered by the subsequent drawings, which include those made and used separately and those made in one combination core.

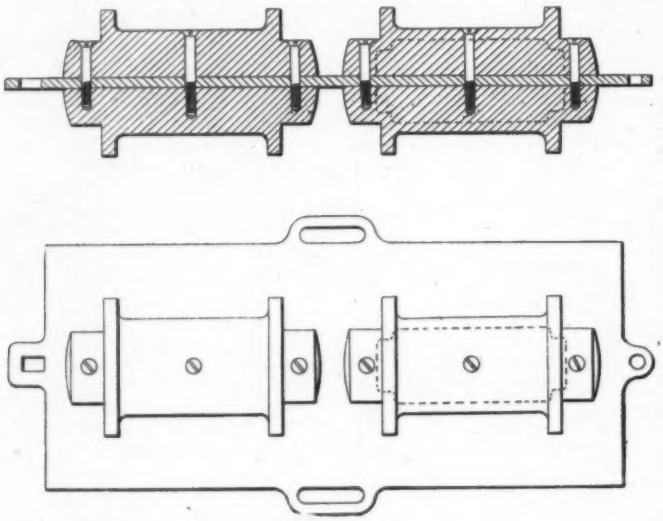


Fig. 5.

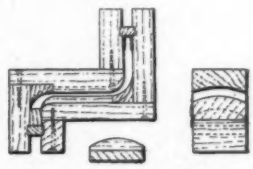


Fig. 6

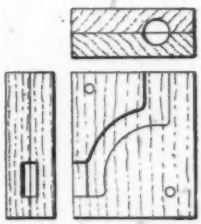


Fig. 7.

The cross-section of the working part of the typical passage box (Fig. 6) corresponds with the section of the steam passage, and its longitudinal outlines with the passage curves, plus the print length at one end. At the opposite end a block is fitted to the curvature of the body core of the cylinder, except in cases where the core enters a print impression in the main or body core. This plan is adopted in some cases in order to avoid risk of the core cutting into the cylinder a little too near to or too far away from the ends. The method of blocking up the core box is shown in the illustration. A small box may be cut solidly, but is more liable to shrink out of shape. An exhaust core box is shown in Fig. 7. It has the necessary print additions at each end. These are the simplest, but also by far the commonest examples of boxes.

Fig. 8 is a very large box for the steam chest of a double-ported low-pressure cylinder, in which

four prints are included for the passage core and one for the exhaust core. The sides of the chest are ribbed, and there are return flanges. The ports are about 2 ft. long. The widths of the cores come out about ⅛ in. wider at the centre than at the ends, the hard cores resisting shrinkage. The prints are blocked up on a wide board with open joints. Loose strips are fitted to be tooled square across. The main outer frame is made with ends rebated into the sides.

Fig. 9 is an example in which the passage cores and nearly the whole of the exhaust core are included in the steam-chest box. The entire core is carried by the print impression on the steam chest, which is a type where the chest is cast in one with the cylinder, and closed with a plain cover. The pieces A that form the outside of the passage cores are divided along the centre and dowelled to permit of delivery. Blocking B is inserted to include abuts against the cylinder core. In the exhaust position the thickness of metal in the cylinder body is formed. The sections which form the metal that flank the passages are coerced next the cylinder by the method of their insertion. Away from there they are secured with a strip A. The top facing for the valve is held with two strips B, one only being shown.

Fig. 11 is a box for a steam jacket for a small engine. Here timber and labour are saved by using a strickle to form the outside of the core. The ramming is also less troublesome than ramming a deep core in the narrow space *a* would be. The inner portion of the box is a solid body with two portions left loose for easy withdrawal. The strickle is guided by the edges of the end pieces.

One of the difficulties inseparable from all cylinder work is the venting. Some intricate cylinders are practically "all cores," and each one

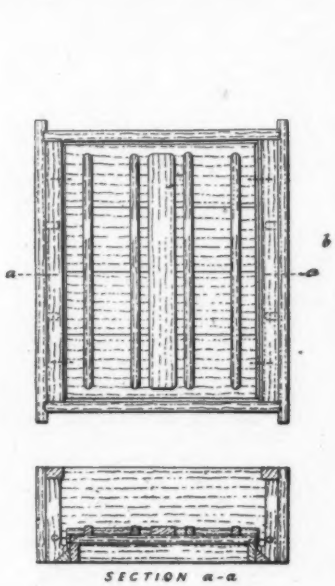


FIG. 8

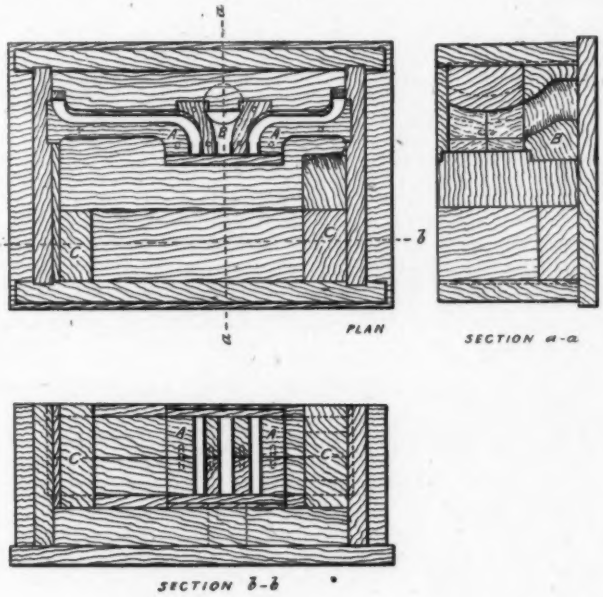


FIG. 9.

the branch portion of the exhaust core in order to avoid an abutting joint there. There is no print at that end for that core. It simply abuts against the mould, its correct position being ensured by the setting of the main core in the steam-chest print impression, and the abutment of the passage cores against the main core for the cylinder bore. The recessing-in of the passage blocks prevents them from becoming shifted during ramming. The blocking up at C, C is to form the return flange of the chest, and the width of the steam chest print. The constructive details will be understood from the shaded drawing without explanation.

Fig. 10 is a plan view of a somewhat similar box for a high-pressure cylinder, but the exhaust passage core is not completed, a plain outlet branch core being set in a print impression from the pattern. But the main portion of the exhaust is formed in one with the steam-chest portion. The core fits into the print impression of the latter and must be adequately vented, and each vent be secured so that the air shall escape to the outside only. Large cores, as those for steam chests cast with their cylinders, are rammed on a grid and have their interiors filled with a body of cinders into which the vents formed by the wire pass as in other work of this kind. One large main vent hole then conveys the air out through the print face.

The nature of the skeleton of a core depends both on its dimensions and its shape. The larger cores of approximately rectangular or circular outlines have grids. Cylindrical cores are carried on bars if large, and swept up on rods or wires if small, and rammed in a box. Cores which are curved longitudinally or have other intricate shapes are supported on rods or wires similarly curved or shaped. In all these cases lightness is considered as far as is consistent with rigidity sufficient to resist distortion under the mass of the core. Cores of different kinds impose corresponding differences in the skeleton frameworks.

In the large cores (Fig. 12) the cast-iron grid forms but one portion of the skeleton. If the core has weak sections and overhanging parts, rods or nails or both are required in addition. These must be long enough to afford adequate support to the sand. The framework of a large intricate core has to be thought out as carefully as that of a mould.

The common form of passage cores is that shown in the group of Fig. 13. These are stiffened and

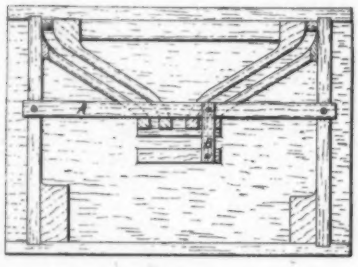


FIG. 10.

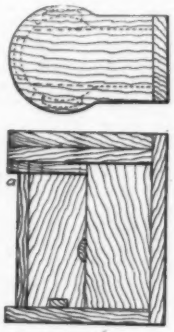


FIG. 11.

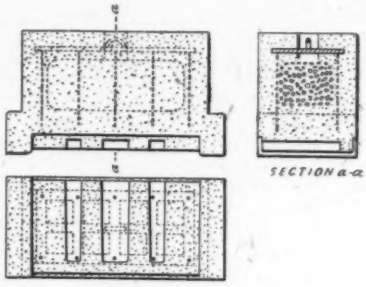


FIG. 12.

vented, and the bringing-off of the vents is a matter requiring care. The stiffening is usually done with rods inserted in the box, curved to the outline and rammed in the body of the core, four or five such rods being used. Sometimes in the large cores a light grid is formed by the union of these rods with others growing crosswise. In others bent rods are cast into an iron grid rammed in the print end.

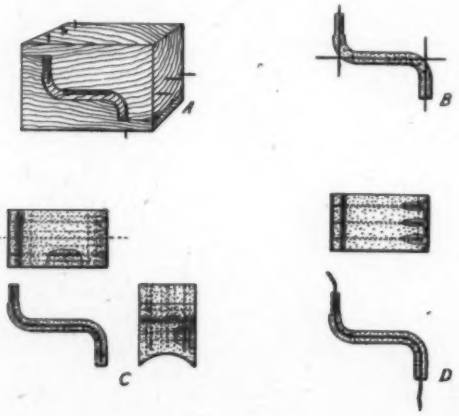


FIG. 13.

An eye is formed on one of the rods for the purpose of fastening the core against the valve face.

The venting is variously accomplished by wires or by strings, the precise methods depending on the size and the outline of the core. For cores of large and moderate dimensions rods or the smaller wires are used. Then holes are bored in the core box in suitable positions and the wires thrust through and rammed in place (Fig. 13A). These must be kept quite centrally, since if the vents come too close to one side the metal might burst in at the time of casting, and fill the vent and spoil the casting. These wires are drawn out when the core is rammed (Fig. 13B), and the core subsequently removed from the box and dried. The curved portions of the vents are formed as follows:—Narrow grooves are filed round the curved portions, and strings inserted to connect the curved vents, the ends of the strings being brought out at the termination of the vents. Then some damp core-sand is filled in over the strings, and the strings are withdrawn, leaving the vent continuous round the curve (Fig. 13C). Vent strings are often used for the smaller cores in preference to wires. They are then rammed in their correct positions, curves included, in the cores, and are drawn out either while the cores are green or when they are dried. If drawn out while green, a proper precaution to take is to ram a wire or two at the angle to prevent the string from cutting through the core (Fig. 13D), by reason of the tendency of the pull to cause the string to straighten.

In very small cores a good plan is to well grease the string and allow it to become carbonised in the drying of the core. This, with the melting out of the grease, will usually allow of the blowing out of the charred remains with bellows, thus leaving a clear vent through.

The exhaust port core is made, one half in each half-box, and cemented in the joint. Stout wires are rammed in it for the purpose of stiffening. The vent is made by cutting out a channel down the centre of each joint face before cementing them together.

GLUCINIUM.—A writer in a recent issue of "Revista Minera" points out the possibilities of glucinium, called by him "a new useful metal," which is lighter than aluminium (specific gravity 1.64, as against 2.56), and is said to be twice as strong. Its specific heat is higher than that of any other known useful metal, and it has a very high fusion point. The oxide glucina (GlO) forms, combined with alumina a silicate, which is the basis of emerald (beryl=6 $Si\,0_2 Al_2 0_3$, 3 GlO) of which there are many non-precious varieties found in many parts of the world. The only firm who produce glucinium on a commercial scale are Giulini Bros., of Ludwigshalen, on the Rhine. The metal is white, malleable, and not attacked by the air.

MESSRS. C. M. RICARD, I. O. Freiwald, and W. E. Earle, trading as Ricard & Freiwald, metal merchants, 120, Fenchurch Street, London, E.C.3, have dissolved partnership.

Standardisation of Foundry Practice.*

By S. W. Wise.

When speaking of "Standardisation," the writer does not mean a system that would tend to destroy the initiative of the individual—that we should become a nation of specialised units with fixed notions, and all thinking and acting in one groove. There are limits beyond which it would be unwise to go; but a system under which certain fundamental principles would be laid down to be followed and under which there would be less diversity of opinion on matters affecting normal shop practice than there is at the present time.

It is perhaps an exaggeration to say that there are now questions on which no two men think alike; but it is undoubtedly true that there is a considerable amount of controversy on subjects that should have been placed beyond dispute long ago. It is difficult to find reasons why they are still contentious but local conditions have something to do with it. The variety of purposes for which foundry products are made, the unreliability of the materials that are used, and the generally bad conditions under which most foundry operations are performed, are all contributing causes.

A shop engaged on comparatively unimportant work, or at least on work that has not to stand up to severe service conditions, adopts certain working methods, and no real trouble results. Its practice is accordingly labelled standard, from which no one must depart; but this same practice might not hold good if other work was taken in hand which was the subject of closer examination and tests.

The extremists are divided into two classes, those who think that a cupola is a law unto itself, and others who hold the view that cupola practice can be reduced to an exact science. A number of us are inclined to think that the cupola is never two days alike. There is no unanimity of thought as to what is good practice in the details of cupola working, but it is very probable that the various opinions expressed have been put forward as the result of actual experience, and published in perfectly good faith. The root of the trouble is that the detailed conditions connected with the working have not been mentioned, and the many variable factors over which the founder has little or no control have been ignored. This view is confirmed by Table I., which shows different rates of melting per hour for 130 consecutive "blows" from a 33-in. cupola, which was operated as far as shop conditions would allow in exactly the same manner on each occasion, the air being supplied by a fan. The fire was lit at about the same time each day, a portion of the coke bed was allowed to burn through before the remainder of the bed was put on and its height measured from the charging door; the charges of metal were of equal weight, the coke in the charge was measured, and the cupola was charged right up to the charging door before the blow was commenced. The mixture of metal was controlled chemically, Keep and "K" tests were taken daily. It was also essential that the castings produced should be of a certain degree of hardness, and they were for this purpose the subject of Brinell tests. So that as far as the metal was concerned the character of the scrap was the only variable factor. No attempt was made to get good coke ratios or record rates of melting, the whole method of operation was based on what was considered to

TABLE I.—*Analysis of Melting Rates* (130 "*Blows*").

Percentage of Total blows.	Tons melted per hour.	Cubic feet of air per min.	Cubic feet of air per ton per hour.
7	3.2 and under	1,700	31,800
11	3.4	1,800	31,700
22	3.6	1,800	30,000
36	3.8	1,900	30,000
12	4.0	1,900	28,500
8	4.2	2,000	28,500
4	4.4 and over	1,900	26,000

TABLE II.

Time.	Cubic feet of air per min.	Pressure at Tuyeres in ozs.	Amperes.	Per cent. Humidity.	Temperature Fahr.	Charges, (5 cwts.)	Ladles.
0	2,600	11	20	80	52	9	—
5	2,300	11	18	80	52	9	—
10	2,300	11	18	80	52	9	—
15	2,300	11	18	80	52	9	3
20	2,000	10½	17	70	54	10	9
25	2,000	10½	17	70	54	11	13
30	1,600	10½	16	70	54	13	16
35	1,600	10½	16	70	54	15	22
40	1,600	10½	16	70	54	16	25
45	1,600	10½	16	70	54	18	30
50	1,600	10½	16	70	54	20	32
55	1,700	10½	16	70	54	21	34
60	1,700	10½	16	70	54	22	40
65	2,000	10½	17	70	54	—	49
70	2,000	10½	17	70	54	—	52
75	2,000	10½	17	70	54	—	58
80	2,600	10½	20	70	54	—	65
85	2,500	6½	19	70	54	—	70
Averages	2,000	10½	17¼	72	53.5	—	—

Area of Cupola at Tuyeres = 850 sq.in. } Ratio = 4.1 to 1
" Tuyeres = 208 " }
Tons melted per hour = 3.88
" " " per sq. ft. of area = 0.646

Tons melted per hour per ft. dia. at Tuyeres = 1.41
Cubic feet of air per minute = 2,000
" " " hour per ton = 31,000

* Read before the Newcastle Branch of the British Foundrymen's Association, November 30, 1918; Mr. J. D. Carmichael in the chair.

be the best practice in order to have the metal ready at the time it was required and at a temperature suitable for the work in hand, certain steps being taken to ensure it being hot enough for the purpose.

An examination of Table I. will show that the rate of melting varied considerably, but the volume of air used per minute was not quite so variable. On the face of these results one would be justified

TABLE III.

Time.	Cubic ft. of air per min.	Pressure at Tuyeres in ozs.	Amperes	Charges (5 cwts.).	Ladles.
0	1,900	11	17	10	—
5	1,900	11	17	10	—
10	1,700	10½	16	10	1
15	1,600	10½	16	10	1
20	1,600	10½	16	11	5
25	1,600	10½	16	12	10
30	1,500	10½	16	13	14
35	1,400	10½	16	14	18
40	1,500	10½	16	16	26
45	1,300	10½	16	17	29
50	1,300	10½	16	18	32
55	1,300	10½	16	18	38
60	1,300	10½	16	19	38
65	1,300	10½	16	19	41
70	1,300	10	16	20	44
75	1,300	10	16	21	50
80	1,300	10	16	22	53
85	1,300	10	16	22	56
90	1,300	10	16	22	62
95	1,400	10	16	25	65
100	1,300	10	16	27	68
105	1,200	10	15	—	72
110	1,200	10	15	—	75
115	1,200	10	15	—	78
120	1,200	10	15	—	79
125	1,250	10	15	—	84
130	1,200	10½	16	—	90
Avges.	1,394	10½	16	—	—

Area of cupola at Tuyeres=850 / Area of Tuyeres .. .. = 52	Ratio 16.3 to 1	
Tons melted per hour	=	3.11
Tons melted per sq. ft. of area	=	0.52
Tons melted per ft. diameter at Tuyeres ..	=	1.13
Cubic ft. of air per min.	=	1,394
Cubic ft. of air per hour per ton	=	26,900

in claiming that this particular cupola melted iron at the rate of 3¾ tons per hour, and used 30,000 cub. ft. of air per hour during the operation. This would be regarded as good practice—but a study of the individual casts is not, however, quite so satisfactory. It will therefore be of interest if we consider a few of the conditions which affect results as far as the rate of melting, and the volume of air used is concerned.

Table II. is the record of what takes place during a blow. In the first column the time is recorded, the observations being taken every five minutes throughout the cast; the volume of air per minute is next indicated; this was read off from the blast meter. It will be noticed that a comparatively large quantity of air was admitted at the commencement, gradually decreasing for a time, after which the volume was fairly constant until towards the end more air was admitted.

Mention has frequently been made of the varying quantity of air required to melt a ton of metal. On the particular day's operation here recorded it took 31,00[illegible] cub. ft. per ton per hour. It is, however, obvious to all that this amount would vary considerably if the duration of the cast was altered; or, to put this somewhat differently, the volume of air used per minute is, to some extent, dependent on the amount of metal melted. The state of the cupola lining also affects the volume of air admitted, this being much less during the "blows" immediately after re-lining than during those at a later period; the early slagging up of the cupola during a particular day's work is another element of uncertainty.

The effect of different tuyere areas on the volume of air admitted is very clearly shown if Table III. is contrasted with Table II. Possibly there are more differences of opinion on the question of tuyere ratios than on many others, but as far as the observations made during the period under review are concerned, the results with a 16 to 1 ratio as shown on Table III. were not considered satisfactory; certainly it took less air per minute, and, consequently, less power was necessary, but the melting rate was only 3.1 tons per hour. Apart from the delay in completing the day's work, the state of the cupola after the cast was finished, left much to be desired—it was, in fact, nearly bridged over. The best ratio was found to be about 6 to 1, although for various reasons the normal working ratio was 4 to 1.

The temperature of the air also affects the rate of melting, and, of course, the volume of air blown into the cupola. The same may also be said of the moisture in the air.

Careful notes of these two conditions were taken at frequent intervals over an extended period, but it was difficult to get extreme readings and at the same time have everything else equal. The results were not conclusive, but, speaking broadly, the best days as far as melting was concerned, were cold, dry days, although moisture did not affect the results so adversely at a low temperature as it did at a higher one. Both conditions change very much even during an afternoon; a variation of as much as 40 per cent. has, on occasion, been recorded.

The height of the charging door from the hearth

TABLE IV.

Time.	Cub. ft. of air per min.	Pressure at Tuyeres in ozs.	Amperes.	Charges (5 cwts.).	Ladles.
0	2,600	10½	20	5	—
5	2,500	10½	19	5	—
10	2,500	10½	19	5	—
15	2,200	10½	17	7	3
20	2,000	10½	17	8	6
25	1,700	10½	16	10	16
30	1,700	10½	16	12	21
35	1,700	10½	16	13	26
40	1,700	10½	16	14	29
45	1,700	10½	16	16	32
50	1,700	10½	16	18	35
55	1,700	10½	16	19	38
60	1,700	10½	16	20	41
65	1,700	10½	16	22	44
70	1,700	10½	16	23	50
75	1,700	10½	16	24	56
80	1,700	10½	16	24	59
85	1,700	10½	16	25	67
90	1,700	10½	16	—	71
95	1,700	10½	16	—	77
100	1,800	7	16	—	83
Avges.	1,860	10¼	16¼	—	—

Area of cupola at Tuyeres .. .. .. = 850 / Area of Tuyeres .. .. .. = 208	Ratio 4.1 to 1	
Tons melted per hour	=	3.75
Tons melted per hour per sq. ft. of area ..	=	0.625
Tons melted per hour per sq. ft. dia. at Tuyeres	=	1.36
Cubic ft. of air per minute	=	1,860
Cubic ft. of air per hour per ton	=	29,800

is also frequently discussed, and in this connection Table IV. may be contrasted with Table II. It was found necessary in order to avoid "hanging," owing to the state of the lining and the character of the scrap used, to have but few charges in the cupola at one time during the last two "blows." This lining had had a fairly long life, and though

the results were all right, the increased diameter had probably more to do with them than had the depth of the burden.

One feature of the whole series was the limited use that could be made of the pressure gauge; it gave one no idea of the volume of air that was blown into a cupola during a cast. This volume might vary by hundreds of feet, but there would be little difference in the height of the mercury in the pressure gauge. On the other hand, if a blast meter gives only comparative results, one could at any time see what was taking place whilst the cupola was in operation.

The foregoing are only a few of the different conditions under which many foundry operations are conducted, but are in themselves sufficient to justify the belief that it is well nigh impossible to approach anything like uniform practice, if we are content to compare the practice of one shop with another; there are too many unknown elements connected with the task. It could only be done by a system of exhaustive experiments, carried out under such conditions as would ensure the variable factors being under control; where the question of profit and loss would have no disturbing influence, and the cry for more castings would not be heard.

The idea of a foundry equivalent of the National Laboratory suggests itself, and if the proposed Bureau of Information is intended to go as far as that, it would be the duty of the State to render every assistance. The experiments would be costly and involved, and would have to be conducted by the best men that science and the foundry could produce—people whose findings would be accepted without demur. Considerable time would necessarily elapse before results would be obtained, but in the meantime the financial aspect ought not to be allowed to cause anxiety. In the event of such an Institution being created, when definite conclusions were arrived at, these could be communicated to all interested—possibly through the medium of cupola builders and others responsible for the production and distribution of foundry materials and appliances—more uniform conditions would consequently obtain, and a boon be conferred on one of the most important industries in the world.

Discussion.

The President said that Mr. Wise had given them plenty of food for discussion and reflection.

Mr. Edward Smith said he did not think they would be able to standardise cupola practice. He had known them made all exactly the same size and worked by the same men, and to all appearance everything had been equal, but the results obtained were quite different. In fact, they had to "nurse" cupolas in order to get the results required. Mr. Wise gave it as his opinion that the best result from the cupola was after half an hour's blow. He (the speaker) thought it would be a bad job for the larger foundries if they just got good results after half an hour. In his opinion the furnaces were going best after two hours. The volume of air, said Mr. Wise, was just as high at the finish as at the start, but if they continued they would get intensely hard metal at the finish unless they reduced their blast pressure.

Mr. Weir said he was of opinion they could not get standardisation in that matter, for any foreman would say that his methods were the best, until he got into trouble. Different methods gave equally good results—at least, results with which everyone was satisfied.

The President said that as to the hardness of metal, they might take all the tables and meters which they could think of, but the cupola man was the fellow who put the "baccy" on. If he was a bit late in his charges, trouble resulted, and that accounted for a lot of the hardness at the end of the job. It was acknowledged that there was something they could not regulate in ships. They could build two ships exactly alike, and yet one would give two knots speed more than the other. It might be the same with cupolas; they had whims and fancies, and it was all due to a combination of circumstances which they could not explain. They were somewhat like human beings, who were adversely affected by a dull day. Human beings were suspectible to conditions, and it was just the same with cupolas.

DETERMINATION OF MOISTURE IN COKE. – The following is a summary of the conclusions arrived at by Messrs. A. C. Fieldner and W. A. Selvig, the authors of a Technical Paper issued by the U.S. Bureau of Mines on this subject:—(1) Investigation shows that the influence of temperature, time, humidity of drying atmosphere, and fineness of sample on the determination of moisture in coke may be varied over a considerable range without affecting the result appreciably. (2) Oven temperatures ranging from 105 to 200 deg. C. produced a maximum variation in moisture of not exceeding 0.3 per cent. (3) Coke can be dried to "constant weight" without the usually specified preliminary air-drying. (4) The circulation of air dried by sulphuric acid, through the oven atmosphere, as specified for coal analysis, is unnecessary in the case of coke analysis, there being no measurable difference of results between circulating perfectly dry air through the oven and using in the oven the natural air from the room. (5) Moisture can be determined quickly and with adequate accuracy ($\pm$ 0.5 per cent.) by simply heating to constant weight a large sample of lump coke, in any convenient oven, or on a stove, hot plate, or steam coil at a temperature of 100 to 200 deg. C. Because of its simplicity and flexibility this method may be used advantageously at points where coke consignments are sampled.

ELECTROLYTIC IRON.—The French Société des Aciéries et Forges de Firminy, after a careful study of five different processes, have finally adopted at their Rioupéroux works the Burgess process for making electrolytic iron for their own consumption as a substitute for Swedish iron previously used, but now difficult to obtain, in making crucible steel. The estimated costs of a plant for a daily output of 24 tons, or 8,640 tons per year of 360 days, and 840 vats of £6 each is £25,640, including buildings. The cost of producing a ton of electrolytic iron, according to Dr. Burgess' own estimate, is about 43s. by his process, but according to M. Aimé Coutagne, the chief engineer at Firminy, this figure has somewhat been underestimated. It is based on a power cost of 1,000 kw. years at £10 per kw.-year; technical service and administration costs £1,400; wages for 20 workmen, £3,200; sinking fund, say, £2,000; upkeep and repairs, also £2,000. As M. Coutagne points out, there is not sufficient allowance made for acid used. On the other hand, power cost is figured too high. Dr. Burgess states that with his process iron 99.97 per cent. pure can be produced. The carbon contents of iron made at Rioupéroux varied between 0.015 and 0.064 per cent.; silicon between 0.004 and 0.020; phosphorus between 0.002 and 0.009; sulphur between 0.001 and 0.007; and traces of manganese are to be found. The process employs a feeble current (100 amps. per sq. met.).

Industrial Education.

The following is the presidential address by Mr. R. R. McGowan, delivered recently before the Scottish Branch of the British Foundrymen's Association, at Glasgow :—

It would be impossible to deal exhaustively with a subject of such magnitude in the course of a single address; therefore, I intend to confine my remarks to certain aspects of the subject which I hope may be of interest to you and to our members generally. I do not intend to devote much time to the consideration of past history. My intention is rather to bring some points before you regarding the present need for a thorough investigation into the subject of industrial education and its particular reference to the needs of our own trade. The object is to present the claims of foundrymen to those whose duty it will be to provide facilities for the educational needs of the younger members of the calling. Our status as leaders of the world's trade has been challenged, and it is therefore the duty of every member of our great Empire to assist as far as lies within his power to resist this challenge, by adopting all the available means for developing and strengthening our country's position. What form should this development take?

There is no lack of suggestions for the solving of this problem, and that probably increases its difficulty. Some of the solutions suggested have assumed a political aspect; but, fortunately, the subject of industrial education is non-political in its aspect, and it is immaterial whether our country continues its present policy or adopts any other policy, it must give a prominent place to the subject of industrial education if we are to make any progress of a national character. If a nation wishes to make progress, it must develop its industries, because it is principally from this source that its wealth is derived, and wealth is power. Having established the premise that a nation's prosperity largely depends on its industries, it is surely a nation's duty to nurture its source of power.

By way of introduction, let us consider one or two points relating to the general question of education itself. Education has been defined as " an endeavour on the part of adult members of a human society to shape the development of the coming generation in accordance with its own ideals of life and the training of individuals in the functions to which they are destined." Education has existed as an art from the very infancy of society, and within comparatively recent times it has undergone great improvements in all its branches. There is, however, at the present time a general feeling manifesting itself throughout the country, that the educational needs of certain parts of the community, especially those associated with industry, have not had the attention which the importance of their vocations demand. Up to a certain point the training of all young persons is, or ought to be, substantially the same; the education instilled ought to be of such a character that it should consist not so much in the giving of knowledge in itself, as giving the material for acquiring this knowledge. It should be the aim of every teacher to supply as far as possible the means only of solving problems and not the actual solutions, for by this method the student is made to rely upon his own resources, and to acquire that great personal acquisition, self-reliance and power to reason.

The Art of Reasoning.

The art of reasoning is an accomplishment which Nature does not bestow on all with equal favour. To some this faculty comes as a natural gift, while to others its attainment is only acquired after years of study. To many the art is lost for the lack of applying the principles which go towards its development.

The extent of our reasoning power is limited to a certain degree by the amount of our experience. This in a large measure is true, but it does not necessarily follow. There are many other factors which have a bearing upon the subject, such as our educational training, the interest we have in our work, the confidence which we can instil into our efforts, and, lastly, our natural ability.

Let us consider some of the disadvantages which are due to our inability, through lack of education, to reason out the many problems which we meet in our vocations. The first which presents itself is that it makes us dependent upon others. Now, a man who is unable to reason out for himself the various problems which present themselves in the ordinary course of his work, cannot command his highest value in the labour market. In proportion to a man's dependence upon others, to the same degree does he lose confidence in himself, and to have confidence in its proper degree is one of the first steps towards success.

In an efficient system of industrial education every man could be developed to produce his full value not only to himself and his employer, but also to his country. We have known men who were in many respects fairly capable, but their lack of knowledge in points relating to their trade made them a source of trouble to all who had the misfortune to come into contact with them. Such men seldom have anything original to suggest; and, when a difficulty presents itself, they are completely at the mercy of others for their next move.

Undeveloped Artisans.

It is by reason of this fact that these undeveloped artisans are to be seen in many of our workshops working in squads under the charge of what is termed a leading hand.

What we want in our workshops are men who are able to act on their *own initiative*—men who are able to arrive at a well-reasoned decision when any difficulty presents itself, and who have the power of originality in their ideas; men who are able to arrange work at its initial stages in the best possible way, so that it may be carried through the various departments with expediency and economy.

We do not suggest that under any system of education, be it industrial or otherwise, every man would reach the same degree of efficiency, as there is, and always will be, men whose natural ability is greater than others. A thorough and efficient system of industrial education would develop a higher degree of intellectual efficiency all round, and that is what our country needs at the present time.

Specialisation.

Specialisation makes the study of our industries one of great difficulty, and in no branch of trade is this difficulty more evident than in foundry work. From the earliest time in the history of trade it became evident that men, in order to acquire that proficiency which is necessary to make work of any

value, had to resort to the specialisation of their professions. In the same way when these trades developed, it was found that by dividing them into sections the output could be very much accelerated and the work produced with a greater degree of economy than when it was carried through in its various stages by the same workmen.

A further development of specialisation is to be found in what is known as divisional labour, which has for its aim not only the maximum output, but perfection of workmanship. Specialisation is a subject which affects not only foundrymen, but every other trade, and it is a subject of which much could be said, either in favour or against the principle which underlies this method of producing work.

There are few trades on which so many other trades depend, or which cover such a wide field as that embraced by foundry work. The foundry trade is specialised, in the first instance, under two distinct heads, namely, engineering and general. These, in their turn, are subdivided into a considerable number of sections, each of which forms within itself an important industry. The different varieties of work which find their way into the foundry in one form or another, make foundry work one of the most difficult, yet one of the most interesting branches of trade.

It depends from what point of view it is approached whether the system of specialisation is beneficial or otherwise. The value of specialisation has been proved beyond dispute in all our trades and professions. To the researches of the specialist the community at large are indebted for much. The extensive knowledge which has been acquired by the specialist has not remained with him; it has been acquired for the community at large, and but for the energies of those specialistic workers, information of which we are now the happy possessors would never have reached us. While the discovery of each specialist may be but an atom, the combined work of all has raised professions and industries to their present levels.

There is, however, still much to be accomplished, and we note with pleasure that the Government appointed a special committee recently to investigate and report on the question of industrial research. There are few foundries now existing where some branch of trade is not specialised. Even with these facts presented to us, there is a want of concentration in many of our foundries which we should like to see remedied. Want of concentration may be attributed, in some degree, to the fact that we in this country lack facilities for acquiring knowledge pertaining to our vocations which we know do exist in other countries. It is our duty, then, to press at every opportunity for the establishing in this country of such facilities.

One of the chief advantages to be gained from specialisation is that by catering for a certain class of trade the founder can arrange his plant so that he can quote prices for his particular class of work which others, who are not in the same favourable position, are unable to touch. Moreover, workmen who are continually engaged at one particular class of work become experts, which means that the work can be turned out with the utmost despatch.

Let us look at the other side of the question. Variety of work adds interest to it, and keeps the brain on the move. This cannot be said of certain branches of the foundry trade which are the victims of specialisation. The system of specialisation, looked at from the workers' point of view, is attended by many evils, and for the alleviation of these evils it is difficult to suggest a remedy. When a man is asked to concentrate his energies on one piece of work he may become an expert, but the tendency is for his experience, and his power of observation other than that on which he is immediately engaged, to become limited. In this way his work may get monotonous, and any work which does not keep the brain in that exercise which is necessary for the development of its powers, is bound to have a deteriorating effect on the individual who finds himself placed in these unfortunate circumstances.

There are certain branches of foundry work which make it nearly impossible to treat them otherwise than by specialisation. In such works the problem of how to deal with the educational part of the artisan's training will present some difficulty. It should be made a condition on the part of every employer when a boy enters his employment that he should teach the boy his trade, and that the work given him should be such that he may be developed into a skilled artisan.

The maxim that "every soldier in the British Army carries the baton of a field-marshal in his knapsack" should apply with equal force to every lad entering the field of foundry work. Every boy entering the foundry trade should be made to feel that his work is quite as important as it would be in any other trade, and that facilities should be placed within his reach in order to qualify him for positions of responsibility.

Positions of Responsibility.

The positions of responsibility in the foundry are not attained without distinguished service in the various grades leading up to those higher appointments. To qualify for these positions a man must first have an ideal which it will be his aim to reach. He must then decide what is the best course to adopt in order that his energies may be concentrated towards this ideal, and, finally, he must put the result of his reasoning into a practical form. Promotion seldom comes to a man who has not in some way striven to acquire it. It should be our aim, no matter how insignificant our duty may be, to perform it with that thoroughness which distinguishes the work of an accurate from that of a careless workman. It is only by showing ourselves qualified to deal with matters of the smallest detail that we can acquire that confidence which is necessary to undertake work in which there are greater responsibilities involved. We acknowledge that hitherto, in some instances, positions of responsibility in the foundry have been held by men whose influence, or their gift of speech, was greater than their ability; but we consider cases such as these are becoming less frequent, and happily we are now reaching that point in the history of trade when ability must be recognised. Trained intelligence was not in former years the essential factor which it now is. We have now the industrial activity of many nations to contend with which hitherto did not affect us; it will therefore be fatal to follow the principles which met the conditions of the past.

To be a thoroughly good tradesman, although of much importance, is not the only factor which goes towards the qualifications which are necessary to him who aspires to promotion. He must be conversant with all the most up-to-date principles asso-

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ciated with and pertaining to the foundry. This knowledge is acquired by studying not only the practical but the technical details of the trade. As a result from this study his work will attain its highest value, not only to himself, but to those who are the recipients of his labours. We cannot emphasise too strongly the advantages to be gained by first having acquired a practical training, and a practical knowledge of foundry work should be the first step towards promotion. There are none better able to discuss or give decisions on the various problems which are ever presenting themselves in the foundry than those who have passed through the ranks. Those who hold the higher positions, if they have the advantage of a practical training in addition to the other qualifications which are necessary to all leaders, have an immense advantage over those who have only acquired their information theoretically.

What we wish, then, is the establishment of the necessary provisions at all trade centres for acquiring information with regard to our vocations. To make such institutions successful there must be some means adopted other than that which is at present existing, in order to impress not only upon the men, but also the masters, the necessity for such a course of training. The price must be paid by both, and a little pressure by the Government, encroaching possibly on what is known as the "liberties of the subject," will require to be enforced, until all sections of the community see the mutual advantages which are to be gained from such education.

Industrial Progress.

The progress in foundry work is at the present time in a very backward state, notwithstanding the many improvements which we have been forced to make to meet the demands of the war, and the same might be said of a great many other trades. Prior to the war, the progress of the civilised world was advancing with such rapidity that one was apt to wonder where the avalanche of developments which we saw in all directions was to end.

One of the chief reasons for that activity might be attributed to the competition which then existed between the nations for supremacy in the various fields of commerce in order to meet the demands of the countless millions of consumers throughout the world. So far as we can observe, this competition will be no less severe under peace conditions; in fact, everything points to a period of strenuous commercial activity following the war, and this is one of the many reasons why we wish to press home at every available opportunity the necessity of educating the industrial community, if we are to be in a position to cope with the demands which are certain to be made upon us.

For many decades Britain could rightly be termed the workshop of the world, but she can no longer claim to be absolute in this title. Britain is still a workshop, and a great one. She is, however, today, in almost every respect, only on a par with the other great commercial nations as regards production and selling powers. Britain has no longer a monopoly of the world's markets, and when monopoly ends competition begins.

The position in which we foundrymen find ourselves is that we are now face to face with problems which modern conditions have created, and we as members of an industry which takes no mean part in the trade of our country must endeavour to uphold the position which we have hitherto held as producers in this sphere of our country's trade. We welcome competition if for nothing else than for having been the means of demanding more brain power to bear on many of the methods which hitherto we have adopted. It has been clearly demonstrated to us that if we are to retain that supremacy which has been characteristic of our work in the past, and if we are to keep our position in the world's trade, we must make ourselves efficient and adopt measures for producing our work which will place us in a better, or at least as good a position for doing so as our competitors.

Progress in Foundry Work.

The progress in foundry work generally compares very unfavourably with that made in many of our other industries. This may be attributed to several causes. One is our over cautiousness. It has been argued that foundry work, owing to the peculiar nature of the trade, does not lend itself so naturally to improvement as that of many other trades. This line of reasoning fails when we look at the advancement which has marked the progress of some of our competitors in other countries.

The writer does not wish to infer that the foregoing remarks apply without exception to all our foundries; for in this country we have some of the best equipped foundries to be found anywhere, and we have also foundrymen in all branches of the trade whose equal in ability it would be difficult to find. But many foundries might be brought to a higher point of efficiency in regard to the equipment and the technical ability of the workmen.

The writer would also like to see better provision made for the comfort of the workers. In many foundries there is actually no provision for a man to wash his hands, nor is there any facility for heating food beyond that which the head of a casting provides, and when he dines a moulding box provides his seating accommodation, and an upturned parting-sand box acts as his table. How can a workman give of his best when he is treated in such a manner, or what is the use of talking about education to a man working under such conditions? We note with pleasure the canteen accommodation which the Government demands in works where women are employed, and the same regulations should be enforced with regard to men.

Proposed Schemes.

The subject of industrial education is a question bristling with difficulties, and its application to the needs of apprentice foundrymen does not in the least degree alleviate those difficulties. In an earlier part of this Paper it was noted that education was an endeavour on the part of adult members of a human society to shape the development of the coming generation in accordance with its own ideals of life, and to train them in the work to which they are destined. Here is a duty entrusted to us, and one which should impress us with the responsibility that it carries. No branch of society can ever hope to succeed if it does not in some way cater for the training of its younger members. I appeal to you to give the matter your earnest consideration, and to give all the assistance which is at your disposal, in order to further the interests and progress of our young friends who have decided to follow the trade in which we are engaged. By directing them to pursue a scientific study of the principles associated with their trade, we can make their careers more useful and benefi-

cial, not only to themselves, but to their employers and indirectly to their country.

In the first place I should like to refer to the report issued recently by the British Foundrymen's Association from its Special Committee on Apprentice Training. It is the intention of this Committee to issue reports from time to time as they obtain the necessary information. In their first report the Committee state that the applications to foundry firms for information regarding their methods of training apprentices have been suspended meantime, as such applications were not deemed likely to receive very careful attention until after the war. The Committee, however, however, have proceeded with other branches of that inquiry, and have collected information and opinions from a few of the Branch Committees, also from individuals, and by this means they have arrived at certain preliminary conclusions.

A brief summary of these conclusions is contained in the following notes:—In the majority of foundries in Great Britain there exists no system of apprenticeship which ensures to the employers the services of the boy for any stated number of years, nor is there any system which ensures to the boy a systematic course of instruction such as is requisite for producing a competent foundryman. The progress of the boy at present depends to a great extent on the character of the foreman and on the mental inquisitiveness of the boy himself.

Without doubt the character of the foreman has a very important effect on the younger members of his staff, and if he is a man who has acquired a technical knowledge of his trade in addition to his practical training, he will impress on his apprentices the need for a scientific study of the principles associated with the trade, and will give every encouragement to those who follow this course. There are still foremen at present holding positions in many of our foundries who have never given the scientific side of foundry work its proper place, and who do not in any way encourage the attendance of their apprentices at classes where such training is acquired. Happily, this type of foreman is fast being eliminated, and those who are superseding him are men who merit the position by reason of the technical training which they have acquired in addition to their practical experience. The progress which science has now made demands a high degree of intelligence on the part of those whose duty it is to supervise and conduct the production of work to a successful issue.

At one time there was certainly some excuse for those who lacked a technical knowledge of their trade, because of the fact that facilities for acquiring such information did not exist; but there is now practically no excuse, because these facilities do exist, and may be had at all important trade centres. The equipment in some cases may be a little meagre, but we have the assurance of the educational authorities that if the demand increases more facilities will be made available and the equipment increased.

Time will not permit a complete review of the preliminary findings of this Committe on Apprentice Training. The report, so far as it goes, is one of the best contributions yet published on the subject. I am certain that you will agree with me that a most important point in the question of apprentice training is that a boy, when he enters a trade, should be guaranteed a systematic course of instruction in its various branches, such as is requisite for the production of a competent workman, and I would further recommend that the Government should pass an Act to this effect and appoint inspectors to see that such a course of training is being carried out. The question of apprentice training is not one which acts only upon the employer and the employee; it affects the State, and it is therefore of national importance. The production of competent workmen is becoming less and less every year, owing to this lack of interest regarding the training of apprentices.

Specialisation is another cause of the lack of competent workmen; also the fact that many employers depend to a great extent on cheapening labour by employing boys at repetition work, such as moulding machines, right through their apprenticeship; such lads never develop a knowledge of their trade beyond the limit which this class of work demands.

The New Education Acts.

The next scheme for the training of young artisans which I wish to mention has reference to the new Education Act. The writer notes with pleasure that one of the provisions in this Act is to establish day continuation classes, and to make the attendance at these classes compulsory. This clause has created a considerable amount of discussion and some dissatisfaction in certain quarters. It is argued that the liberties of the subject are being interfered with in compelling the youth of our country to attend such classes; but surely it is time to interfere with such liberties when 90 per cent. of the youth of our country receive no education beyond that which they received up to 14 years of age.

Industrial Research Associations.

As to Industrial Research Associations, several of these have now been established throughout the country as a result of the recommendations of a Special Committee appointed by the Government to investigate and report on the question of industrial research. The objects of the Scottish Association, which, I believe, are characteristic of others, are briefly as follows:—(1) "To promote research and other scientific work in connection with trades and industries. (2) To establish, form, and maintain museums, collections, libraries, etc., and to translate, compile, collect, publish, lend and sell any literature, statistics, and information in connection with trades and industries. (3 To encourage discoveries and inventions in connection with trades and industries. (4) To establish, promote, cooperate with, and receive into union or combine with any other bodies or persons engaged or interested in similar research."

The establishment of these Industrial Research Associations is the result of a general feeling in the minds of thinking men concerned in the success of British industries that a closer co-operation is required among the industrial and the scientific communities of the country, because by a combination of these forces practical problems yet unsolved might be subjected to scientific investigation.

Information Bureau for Foundrymen.

There is a feeling in the minds of some foundrymen that, in addition to these Industrial Research Associations there should be established a system of Information Bureaux bearing directly on each particular trade, and they put forward a claim for the establishment of a Government Information Bureau for Foundry Work. Such institutions, in

conjunction with the general Industrial Research Associations already mentioned, would be able to conduct investigations and supply information for which foundrymen have long been waiting. The British Foundrymen's Association, and other societies of a similar character, are educational institutions which have done an enormous amount of good work in the past, and we are confident that in the future the usefulness of such societies will be greatly extended. The Council of the Scottish Branch of the British Foundrymen's Association has been considering some suggestions, which, if adopted, will, they hope, extend the usefulness of the scientific associations.

One suggestion is that they would like to see a system of co-operation established among the different scientific associations in the country, so that the members of one association would have the right, or the privilege, of attending the meetings of any kindred association. An arrangement to this effect has been established between our Association and West of Scotland Iron and Steel Institute.

Another suggestion we have had under consideration is to try and increase the membership of our Association by having, as far as possible, a representative member of the B.F.A. in every foundry in Scotland. I would fail in my duty as your president if I did not impress upon every member present to make an endeavour to increase the membership of the Scottish Branch; the larger our Association is the more useful it will be in the spread of industrial education, especially that branch pertaining to foundry work.

In conclusion, the writer would like to quote from a recent speech by Lord Haldane:—

Education, he said, was the only means of getting rid of social inequality. If they carried it far enough they would have solved nearly all their problems. Education would give them an aristocracy, not of birth or tradition, but an aristocracy of talent, in which one man was higher than another simply because his work, industry, and concentration had enabled him to take advantage of the opportunities which his neighbour had neglected.

Shell Steels of the Allies.

The Military Testing Bureau at Berlin has analysed and tested specimens of the steel for making shells by the French, English, Russians, etc., and has published the results, as under :—

(1) *Three French* 7.5-*cm. Shells.*—Th analysis of the steel of three 7.5-cm. French shells gave carbon content 0.37 per cent. in two cases (*a* and *c*) and 0.45 per cent. in one case (*b*). The silicon content of *b* was 0.47 and of the other two 0.24 and 0.13 respectively; the manganese content varied between 0.84 and 0.64, and all three steels were low in phosphorus (0.022 to 0.040), and in sulphur (0.020 to 0.030). All three showed presence of copper (0.05 to 0.07). The elastic limit in the case of *a* and *b* was not well defined; in the case of *c* it was 43.18 tons, and the ultimate strength 55.24 tons per sq. in. with 11 per cent. elongation in 2 in. All test pieces were about 3/10 by 3/20 in. The ultimate strength of *b* (the one higher in carbon) was 67.31 with 8 per cent. elongation and that of *a* 46.35 tons per sq. in. with 12 per cent. elongation. The micro-structure of *b* and *c* showed that the metal had been annealed at a comparatively low temperature; steel *b* showed troostite with segregations of ferrite, while *c* had reached the osmondite stage.

(2) *Three Russian* 7.5-*cm. Shells.* — These were coated with nickel on the outside. Only two of them (*a* and *b*) have been analysed, showing 0.65 and 0.44 per cent. carbon respectively, 0.21 and 0.18 per cent. silicon. 0.92 and 0.80 per cent. manganese; phosphorus content was 0.04 per cent. in both cases, sulphur 0.02 and 0.35 per cent.; and copper 0.07 and 0.01 per cent. The elastic limit of *c* was reached at 28.57 tons, and its ultimate strength was found to be 48.26 tons per sq. in. with 16.4 per cent. elongation. The corresponding figures for *a* and *b* were 54.93 and 57.15 tons per sq. in. with 11.3 and 8.0 per cent. elongation. For these three Russian shells the elongation was measured between pop marks 3.2 in. apart. The three shells were evidently produced in different ways. *a* was evidently drawn without subsequent heat treatment, *b* was evidently annealed afterwards, while *c* was also drawn and allowed to cool at a comparatively slow rate, as its micro-structure showed pearlite grains in a net with medium-sized meshes.

(3) *French* 5.6-*cm. Shell.*—The carbon content of this steel was 0.43 per cent., with silicon 0.25, manganese 1.13, phosphorus 0.06, sulphur 0.05, and copper 0.04 per cent. Elastic limit=23.81; ultimate strength =39.69 tons per sq. in, with 25.3 per cent. elongation. The micro-structure showed that the metal was drawn at a high temperature or was subsequently annealed. Some slight inclusions of slag. It showed pearlite grains embedded in a ferrite mass.

(4) 6.4-*cm. Shell of Unknown Origin.*—Carbon 0.30 silicon 0.33, manganese 0.97, phosphorus 0.007, sulphur 0.02, and copper 0.04 per cent. Elastic limit = 45.72; ultimate strength = 52.20 tons per sq. in., with 13.7 per cent elongation The micro-photogram shows a very close-grained, even texture (martensite).

(5) *Two French* 6.4 *Shrapnel.*—Carbon content in both cases 0.36, silicon 0.25,and 0.40, manganese 0.85 and 0.78, phosphorus (0.044), sulphur (0.06), and copper (0.06 per cent) the same in both specimens. Elastic limit =50.86 and 47.94 tons, ultimate strength=56.83 and 56.39 tons per sq. in, with 11.7 and 12.6 per cent. elongation respectively. The micro-photogram of the first shell showed a structure of martensite like No. (4) shell, while the other showed the osmondite stage of transformation.

(6) *Two* 7.5-*cm. Shrapnel.*—These were probably of English origin. The carbon content of (*a*) was 0.47, of the other (*b*) 0.34 per cent., silicon content was 0.33 and 0.19, manganese 0.86 and 0.62, phosphorus 0.085 and 0.063, sulphur 0.04 and 0.06, and copper 0.05 and 0.10 per cent. respectively. The elastic limit of the high-carbon metal (*a*) was 71.75 tons, and its ultimate strength 74.33 tons per sq. in.; the elongation could not be measured owing to the tearing of the end of the test piece. The low-carbon metal (*b*) gave elastic-limit 48.07 tons, and ultimate strength 51.94 tons per sq. in, with 12.6 per cent. elongation. The micro-photogram of (*a*) showed a uniform granular structure, while (*b*) was distinctly sorbitic, not at all what one expected after the results of the tensile tests.

(7) *Russian* 7.5-*cm. Shrapnel.*—Its analysis gave :—Carbon 0.58, silicon 0.18, manganese 0.62, phosphorus 0.014, sulphur 0.012, and copper 0.03. The elastic limit was reached at 56.20 tons, and the ultimate strength was 65.53 tons per sq. in., with 9.8 per cent. elongation. The micro-structure showed a ground mass of pearlite with ferrite grains and a network of thin ferrite threads with large meshes.

(8) *English* 8.3-*cm. Shrapnel.*—The carbon content of this steel was 0.80 per cent., silicon 0.20, manganese 1.08, phosphorus 0.046, sulphur 0.036, and copper 0.03 per cent. Elastic limit = 41.28 tons, and ultimate strength 63.50 tons per sq. in., with 10.5 per cent. elongation. Of all the shells examined, this had the highest carbon content. The manganese content was also high. The micro-photogram showed a uniform granular structure.

British Foundrymen's Association.

LANCASHIRE BRANCH.

Electric Welding of Castings.

This paper, read before the Branch on November 9, 1918, by Lieut.-Commander Jackson, R.N., was published in our issue of December last.

THE CHAIRMAN (Mr. S. Roe) said he had seen this new method in operation, but had never been present at the handling of it. Could the author give them the chemical composition of the electrode containing the aluminium wire which acted as a slag to the steel whilst burning? It had been stated that when burning a casting that had got out of shape they did not trouble to put the casting back to shape, but simply brought the burning apparatus into operation, and continued the burning. Was anything used to fill up the cavities, any chippings or anything of that kind, so as to make the casting the shape it was intended to be at the beginning? The author also mentioned that it was a difficult matter to burn two cast-iron pieces together, and the usual method was to put a piece of steel between the two cast-iron pieces. How did that go on in the machining department? How did the machinist find the steel pieces to cut? In burning cast-iron where the new metal met the old metal they found a very hard spot. Did that occur with the electric-welding process?

MR. PEAKMAN said from a metallurgical point of view he had been interested in all types of welding for the past few years. The conclusion he had arrived at was each method had its own particular merits, but in all cases welding should not be resorted to without subsequent annealing. Particularly was this so when the component was subjected to stress. During recent months he had had a considerable amount of work to do in connection with castings, etc., subjected to high-pressure steam and vibratory stress, and one of the stipulations to the foundryman was that no welding should be done unless followed by suitable annealing. He had met very few failures when this practice had been followed. All people supplying welding apparatus stated that they had never known articles, when properly welded, to break at the point of welding or at the weld itself. This was perfectly true. Dr. W. Rosenhain, on several occasions, had clearly shown that it was due to a peculiar condition of "pearlite" brought about by the steep temperature gradient produced during welding. The point of fracture of welds was usually at the area of the article that had been subjected during the operation to the temperature of about 700 deg. C. Those who had microscopical outfits could easily detect this area of weakness. During annealing the stucture of this area was restored and the normal structure could be restored to the casting.

To the foundrymen present he would say: Do not weld if you can possibly avoid doing so. If you must resort to it, anneal afterwards. Who among them would rather have a welded casting than one which was not welded? Personally he preferred the latter. He would have liked to hear the lecturer's opinion regarding the tipping of tools by electric methods—that is, fitting a high-speed cutting steel to a mild steel shank.

MR. A. E. TIMMINS asked was it absolutely necessary for the Admiralty overseer to give his sanction before welding took place. Taking a job which he illustrated by a diagram, where there was a block of steel with a flaw right through to the extent of 2 ins., was it possible to get it absolutely solid by the arc process, and would the Admiralty accept it? What was the author's opinion of the Thermit process?

MR. SMITH said he should have been sadly disappointed if cast-iron had been left out of the question. He had heard a good deal of what could be done in that direction, and that there were firms who were experts and able to do certain operations. He himself had tried both oxy-acetylene and electric welding on a rather important casting, and in each case it failed. The lecturer had given to him something new in the way of preparation for welding cast-iron—a layer of steel in the fracture. He took it that the fracture had to be opened sufficiently wide to get this layer in. It rather surprised him that there was no preparation in the way of pre-heating. How did the steel unite to the cast-iron? What was the thickness of the layer of steel? Were patches fastened on to the casting and then welded on?

MR. SUTCLIFFE gave a description of several jobs he had carried out. He said he had some acquaintance with acetylene welding on cast-iron, and it did not result satisfactorily.

LIEUT.-COMMR. JACKSON, replying, said he would send to the Chairman the chemical composition of the electrode. As the electrode burned away the material was deposited and filled up the cavities. The question about the two pieces of cast-iron and the intermediate layer of steel he answered by means of a diagram. The casting he showed on the screen was annealed; they always were, and certainly they would not be welded at all unless the Admiralty Overseer gave his permission, and he would not give it without very good reasons. In the case of a valve that permission was given because there was a tremendous difficulty in getting a sound casting, and it was thought it might be done. It was a success, and the valve was now in service. Of course, he did not advocate welding if it could be dispensed with; he much preferred a new casting. Probably the work he had described would not have been done if the desired end could have been reached in any other way, but it was necessary to have the ships ready by the time they were needed to transport troops to the other side of the Atlantic. They achieved their purpose, and it was worth risking a little. He was prepared to go to sea with a job of welding.

He understood the aluminium wire in the electrode was a deoxidising agent. The Thermit process would come to the front; the more it was known the more it would be appreciated. So far as he knew the aluminium and ferrous oxide were component parts of the welding medium.

MR. TIMMINS: Do you mean the aluminium produces sufficient heat?

LIEUT.-COMMR. JACKSON said he understood that was the claim of the patentees. He was not a chemist, but he thought the process worked in this way. Aluminium was used to absorb or take up oxygen. Having got iron oxide in the presence of aluminium, chemical action took place so rapidly that the temperature increased to a degree at which it would melt practically anything that would melt below 1,500 deg. C. The process had been used in several instances to weld the stern frames of ships. He did not know whether the members had noticed it, but in the reports which gave particulars of ships torpedoed and sunk no

return was made of the number of ships raised and repaired. The number was very large, and the electric welding process came in very usefully for the rapid work which was required. The times were critical, and they had to run a little risk.

They were not bound to use cast-iron in patches, but it was most suitable, because it took the welding material easily. But as in other trades, skill in welding had to be acquired.

SCOTTISH BRANCH.

At a meeting of the Scottish Branch of the Association on January 11, Mr. R. R. McGowan (Branch President) in the chair, Mr. John Logan, of the Ardeer Foundry Company, read a paper on "Cupola Notes."

Mr. Logan stated that the cupola was one of the most interesting studies associated with foundry practice, and much of the success of a foundry depended on efficiency of the cupola. The question of cupola efficiency was now becoming a very serious problem owing to the curtailment of the working day. Greater efficiency was being demanded, and this meant to many firms an increase in the size of their cupola, or an increased rate of melting from their existing cupolas. If this greater efficiency was to be obtained, greater care would require to be observed in the working and management of the cupola than had been the case hitherto.

screen (see Fig. 1). Photos were also shown of the incorrect method of charging a cupola (see Fig 2), and the correct method of charging (see Fig. 3). Reference was also made to the various formations and arrangements of cupola tuyeres.

The lecturer stated that in cupolas with a double row of tuyeres greater efficiency could be obtained when the lower row was slightly less in area than the upper row. He also stated that it was nearly essential to use a double row of tuyers where it was necessary from time to time to melt large blocks of scrap. It was also an advantage in all types of cupolas, so far as efficiency was concerned, to keep the top of the last charge well below the level of charging door.

The lecturer wished to acknowledge his indebtedness to the Ardeer Foundry Company for the privileges which he had received from that firm in the preparation of his lecture.

"F.T.J." Bookshelf.

The Technical Analysis of Brass and the Non-Ferrous Alloys. — By William B. Price and Richard K. Meade.—London: Chapman & Hall, Limited, 11, Henrietta Street, Covent Garden, W.C.2. (13s. 6d. net.)

This is the second edition, revised and enlarged, of a book by two American authors, Mr. Price, chief chemist and metallurgist of the Scovill Manufacturing Company, Waterbury, and Mr. Meade, consulting chemical engineer of Baltimore. We are told by Mr. Price in the preface that when the first edition was brought out (in 1911) the chemist and metallurgist who wished to find accurate and quick methods for the analysis of non-ferrous alloys had to search for descriptions of the various methods, and any special apparatus involved, in the transactions of societies, scientific journals, and treatises on general analytical chemistry. As far as the authors were aware theirs was the first attempt to collect into one volume a complete treatment of the subject, and it was their hope that their little book would take a place in non-ferrous chemistry and metallurgy corresponding to that held by Blair's "Chemical Analysis of Iron," in the ferrous metals. In preparing this new edition we are further told a large portion of the text has been re-written, and many changes have been made based on the helpful criticisms of the first

Fig. 1.

Fig 2.

Fig. 3.

When an increase was demanded from large cupolas, a very serious problem presented itself; it either meant an additional cupola, or an increase in the cross-sectional area of those existing. With round cupolas of large diameter there was some difficulty in getting the air into the centre, and the lecturer suggested making large cupolas elongated in section in preference to making them round; by this method the tuyeres could be placed at a reasonable distance apart, i.e., a cupola might measure 6 ft. across its long axis, and 3 ft. across its short axis, and the same strength of blast as supplied to a 3 ft. diameter cupola would be sufficient, although there were 1,296 square inches more area in elongated section than in the round section. A photograph of a temporarily built cupola of this elongated type was exhibited on the

edition, and an effort has been made to bring the treatise strictly up to date.

The subject matter is arranged in four parts, the first of which deals with engineering alloys generally, and describes also in detail, with illustrations, the apparatus used in electro-chemical analysis. Part II. is devoted to the "Determination of the Metals," from aluminium to zinc, in their alphabetical order, some 17 substances in all, including the non-metallic elements phosphorus, silica, and sulphur. In recent years some of the rarer metals which were formerly used exclusively in the ferrous industries have, to some extent, been found useful in the non-ferrous field, also mostly in the form of alloys, such as chrome copper, titanium copper, and vanadium copper. Methods for the complete analysis of these and others, with important additions in the present edition, will be found in Part III. At the present time, when there is so much controversy about the effect of cadmium in brass and in non-ferrous alloys, the authors thought that it was of paramount importance that an accurate method should be used for its determination. They can confidently recommend the method given in their book.

As regards electro-plating, until recent years the successful plater has kept his baths in working order mostly by rule of thumb, but it has now become necessary for him to analyse his solutions with some intelligence. The authors, therefore, thought it advisable to embody in this new edition a section on the "Control and Analysis of Plating Solutions," which forms Part IV. of their book. Tables of international atomic weights for 1916, and of factors for use in alloy analysis (with their logarithms) are added at the end, and there is an index.

Industrial League Journal.—Published by the Industrial League, 56, Victoria Street, London, S.W.1. (Price 6d.)

The second number of this publication, recently issued, includes contributions from the Right Hon. G. H. Roberts, M.P. (Minister of Labour), the Right Hon. J. R. Clynes, M.P. (late Minister of Food), Mr. G. J. Wardle, M.P. (Parliamentary Secretary of the Board of Trade), and others. There is also a report of a conference on profit-sharing schemes.

How to Form a Company.—By H. W. JORDAN, London: Jordan & Sons, Limited, 116 and 117, Chancery Lane, W.C.2. (Price 1s. 4d., post free.)

This is the twelfth edition of a very useful publication by the managing director of Messrs. Jordan & Sons, Limited, company registration agents. The author deals in such a straight-forward way with the intricacies of company formation and registration, its advantages, and other features, that the book should be in the hands of every business man.

Queries and Replies.

Swampy Foundry Floor.

Reply.—The following is the writer's experience with two large engineering firms, one of which adapted the idea. A steel or wrought-iron tank, rivetted together and made to the requirements of large jobs, was bedded in the floor so as to be safe and reliable. One should never resort to bedding jobs in as long as boxes can be obtained, which give better results in output and quality of castings. The suggestion given in the query is rather good, but water is powerful, and it would not be safe to go more than 3 ft. in the floor with any job; but that problem is easily solved. If the job is a deep one, make frames the same size as the top part in various depths to suit the job. There is then no danger. If it is decided to use a tank, keep it two feet below the foundry floor, then it will not be inconvenient when staking top parts for odd jobs, and if there are 3 or 4 in. holes on each side of the tank near the top edge, 4 ft. apart, they will be advantageous for inserting large hooks and fastening jobs down complete.—Thomas Hennefer.

Reply.—The writer would have a well put in the shop to a depth of about 10 ft., and placed near some machinery if there is any, so as to cost as little as possible. Then place a pump by the side of the well, and have it driven off the machinery. Also erect a tank outside about 6 or 8 ft. square, and about 3 ft. deep, placed 8 ft. from the floor, and pump the water into this tank. Further, have pipes connected from the tank to various parts of the shop to fill small tanks with water so that the water will do for watering the sand after casting.—P. Hope.

Treatise on Cupola Practice.

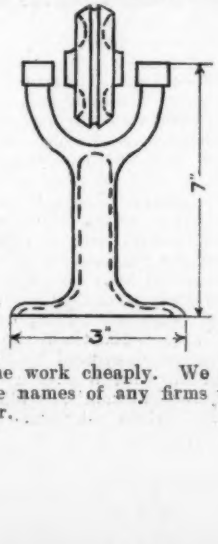
Reply.—Probably the best practical treatise on this subject is "The Cupola Furnace," by E. Kirk, published by E. & F. N. Spon, 125, Strand, London, W.C.

Cost of Producing Castings.

Reply.—The cost of a casting, in the first place, depends on the facilities available for producing the work. For instance, the writer knows an engineering firm which has been making a casting of their own type and speciality for ten years, costing six pounds each in the foundry. Recently another firm produced them for four pounds each, the men at the same time earning better wages than with the other firm, as a result of proper facilities and a well-equipped foundry. The nature of jobbing work varies in every district—light and heavy, plain and complicated; but it has always been the writer's experience that you ascertain the cost of production of high-class castings, and can almost demand the same price at any time, which is from £24 per ton and upwards at present. A thoroughly practical man is needed to take up jobbing foundry work. He has to picture in his mind what tackle, boxes and other facilities are required, and know how to make boxes suitable for a dozen jobs, which is the most important point in obtaining satisfactory results and good output.—Thomas Hennefer.

Grinder-Head and Pulley.

A subscriber forwards the sketch given here of a small grinder-head and pulley, and asks for the names of firms who have machine moulding plants



and can do the work cheaply. We shall be glad to forward the names of any firms who write us to the inquirer.

Difficult Steel Castings.

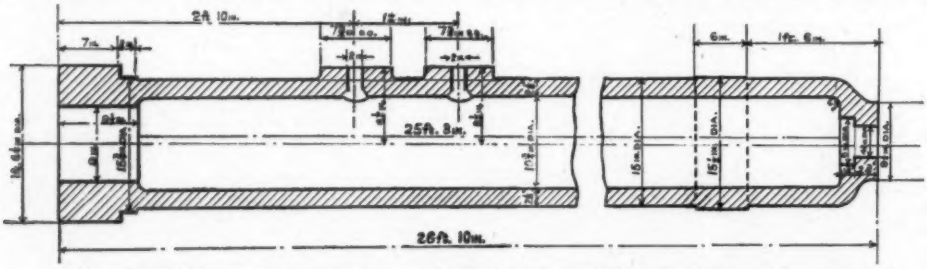
We extract the following details from the address with which Sir Robert Hadfield, Bart., the President, opened the general discussion of the subject of "Occlusion of Gases by Metals," at a recent meeting of the Faraday Society:—

It is now possible—the address stated—to produce steel castings of all kinds and weights of perfectly sound material, provided the section is not too thin. As an instance, the President described a particular application, namely, hydraulic cylinders for cotton baling presses with the production of which his firm had been most successful, largely owing to the careful study they had made of the art of producing sound steel. These cylinders, cast of steel and not forged or pressed in any way, are of a particularly difficult nature, in some cases running up to lengths of over 30 ft. Such considerable length is for the purpose of obtaining a very long stroke in pressing at the same time as many cotton bales as possible. The complete presses are made in this country and sent out to India, Egypt and elsewhere. The ram is usually comparatively small, 7, 8, or 9 in. diameter; the walls of the cylinders must be as thin as possible in order to save weight, and yet must stand the severe hydraulic test pressure of about 4 tons per sq. in., and they must be guaranteed to work constantly day and night during the baling season at pressures up to 3 tons per sq. in.

In order to bring home to the meeting the problem which has had to be solved by the makers of these cylinders in cast steel, not forged or otherwise worked, Sir Robert Hadfield had had a diagram made in full-size section of a particular cotton-press cylinder. In this case the diameter of the ram was 9 in., the stroke 26 ft., the working and test pressures ranging from 3 to 4 tons per sq. in. as already stated. There must not be the slightest weeping or oozing through the walls, as if the pressure was not fully maintained the baling would be a failure, the bales would not be packed sufficiently tightly, and therefore occupy far too large a room in shipment from the cotton growing district to the cotton mills in Lancashire and elsewhere. To bring home the severity of this hydraulic test, it may be stated that the total internal area of the working surface subject to the high pressure mentioned, amounts to about 10,400 sq. in., in not one square inch of which must there be the slightest unsoundness or porosity. The testing pressure is about 100 times the pressure at the nozzles of the hosepipes used by the London Fire Brigade when throwing a stream of water 1¼ in. diameter to a vertical height of 165 ft.—that is, 20 ft. above the Nelson Monument in Trafalgar Square.

In the early 'eighties these cylinders were made of forged and fluid compressed steel produced by the Whitworth process, for which a very high price was paid. However, by the careful study of the cause and action of occluded gases, their prevention, the best steel for the purpose and the best methods of moulding the cylinders and the pouring of the steel, Messrs. Hadfields, of Sheffield, many years ago gradually overcame the difficulties and became able to meet the severe requirements by making a hydraulic cylinder costing about half the price of one made by the Whitworth process. Thousands of such cylinders as the one shown in our illustration are in use all over the world, giving entire satisfaction.

The problem of satisfactorily producing such a casting is greatly increased and intensified by the severe contraction met with in the cooling down of molten steel from about 1,540 deg. C. This contraction is slightly over ¼ in. per ft., thus adding to the practical difficulties experienced, the mould for such cylinders being required to be about 7 in. longer than the cylinder itself is when cooled down. The example is a typical one and helps to explain how important has been the advantage of studying by means of scientific methods the question of getting rid of occluded gases. It should be remembered that fluid steel is at a very high temperature, and in the first part of the pouring into the mould there is a drop of about 30 ft. down the narrow space to form the walls of these cylinders for cotton presses, which in some cases are only about 1¼ in. thick, and very seldom more than 2¼ in. Bearing in mind, too, that the fluid steel when being poured is at the temperature of some 1,540 deg. C. and that gases are given off from the sides of the mould which is formed of fire-resisting material such as silica sand, composition and other mixtures, it will be readily seen—specially with regard to the early poured steel dropping that long distance—how great must be the tendency of the molten steel to absorb gases and to become unsound. It must be remembered also that molten steel, which is quite fluid at from, say, 1,500 to 1,540 deg. C., immediately below these temperatures, has more the consistency of thick cream, and not many degrees lower it is quite pasty. The great difficulties, therefore, of working within these narrow margins of fluidity and semi-solidity will be readily understood. It will, therefore, be admitted that the study of methods which get rid of occluded gases is of the highest service to the constructive engineer, and that our gratitude is due to those French metallurgists who, in the early days of the development of ferrous metallurgy, attacked this severe and complex problem of giving us ferro-alloys by the aid of which we could obtain the necessary sound steel free from blow holes, occluded gases, and other defects.



Cast-Steel Hydraulic Cylinder for Cotton Press, by Hadfield's, Ltd., Sheffield.

Order of the British Empire.

The King has awarded the following promotions in, and appointments to, the Most Excellent Order of the British Empire, in recognition of services in connection with the war :—

Knights Grand Cross (Civil Division).

Ellis, Sir Charles Edward, K.C.B., Member of Ministry of Munitions Council and Representative of the Ministry in France and Italy ; late managing director, John Brown & Company, Limited.

Knights Commanders (Civil Division).

Budd, Cecil Lindsay, C.B.E., member of Non-ferrous Materials Department, Ministry of Munitions ; chairman of the Copper Committee and British Representative on the Inter-Allied Non-Ferrous Materials Committee.

Jones, William John, C.B.E., member of Iron and Steel Production Department, Ministry of Munitions.

McLaren, John, J.P., chairman, Board of Control, National Ordnance Factories, Leeds, Ministry of Munitions ; chairman of J. & H. McLaren, Midland Engine Works, Leeds.

Mansell, Lieut.-Colonel John Herbert, D.L., managing director, Coventry Ordnance Works.

Thom, William, chairman, Blackburn Board of Management, Ministry of Munitions ; member of the Engineering Trades (New Industries) Committee of the Ministry of Reconstruction ; director of Yates & Thom, Limited.

Wormald, John, chairman of the General Service and Industries Committees, War Priorities Committee ; managing director, Mather & Platt, Limited.

Commanders (Civil Division).

Banister, George Henry, special director, Vickers, Limited.

Benthall, Major John Lawrence, T.D., director, Vickers, Limited.

Garnett, James Clerk Maxwell, principal, Municipal College of Technology, Manchester.

Keay, James Donald, engine works manager, Harland & Wolff, Limited.

Officers (Civil Division).

Booth, Alfred Watson, managing director, J. Booth and Bros., Limited, Rodley, Leeds.

Ferguson, Louis, senior partner and managing director, Ferguson Bros., Limited, Port Glasgow.

Fulton, Hamilton, managing director, Martinsyde, Limited.

Goodall, Clarence Noel, managing director, Robert Stephenson & Company, Limited.

McFarlane, Lauchlan Grant, assistant manager, Cammell, Laird & Company, Limited, Birkenhead.

Pate, George, managing director, the Carron Company ; member, Edinburgh Munitions Board of Management.

Taylor, William, chairman and managing director, Taylor, Taylor & Hobson, Limited.

Williams, Harris Gregory, assistant to general manager, Messrs. Armstrong & Company, Newcastle.

Members (Civil Division).

Alcock, Edgar, Director and Works Manager, The Hunslet Engine Company, Limited.

Barton, Gilbert William, Works Manager, Messrs. Henry Bessemer & Company, Limited.

Baxter, Harry Percy, Steelworks Manager, Messrs. Edgar Allen & Company, Limited.

Bourn, George, Manager with Coventry Ordnance Works, Limited.

Butler, John Lawrence, Chief Foreman, Breech Mechanism Shop, Messrs. Wm. Beardmore & Company, Limited.

Ewen, Elias, Manager, Boiler Shop, Messrs. Swan, Hunter & Wigham Richardson, Limited, Newcastle.

Gray, Andrew, Works Manager, the Lanarkshire Steel Company, Limited.

Kay, Edward, Works Manager, Messrs. Thomas Firth & Sons, Limited.

Proctor, Vernon, Assistant Works Manager at one of Cammell, Laird & Company's Works.

Ramsay, James, Manager, Erith Works, Vickers, Limited.

Ridsdale, Herbert Wheatley, Manager of Whitehead Torpedo Factory, Weymouth.

Iron and Steel Stocks.

After discussion with the industries concerned, the Ministry of Munitions has now made the under-noted arrangements in respect of stocks of iron and steel :—

As regards such stocks held by makers, stockholders or other persons dealing in or being consumers of iron or steel, it is considered reasonable that stocks should be restored to a normal level out of subsidised material. It is, therefore, proposed that such persons should be permitted, without any claim by the Ministry for repayment of subsidies, to replenish their stocks up to a total not exceeding 100 tons above the amount held by them on October 31, 1915 (being a date prior to the period of control), or October 31, 1918 (being a date approximating to the conclusion of hostilities), whichever amount may be the greater. On any excess, however, beyond these quantities free of rebate, each person will be required to pay to the Ministry of Munitions a sum per ton, to be announced at an early date, in respect of the subsidies on any such excess held by him as at April 30, 1919.

In order to carry out this scheme an order will shortly be issued requiring all persons holding on April 30, 1919, 100 tons or more of iron and steel, or either of them, to make a return to the Ministry of Munitions of their stocks (a) at October 31, 1915, or October 31, 1918 (whichever may be the greater), and (b) at April 30, 1919. This return will be subject to verification by the firm's auditors or by the accountants of the Ministry of Munitions, and will be in accordance with a form shortly to be issued. This form will be as simple as possible, and will exclude special classes of iron and steel which are not subject to subsidy.

All iron and steel not actually incorporated in any building structure or work in progress will be regarded as stock to which the above applies. The order will further contain provisions for securing payment to the Ministry of the sums above mentioned in respect of any excess stock. In order to secure equity of distribution of iron and steel the Minister of Munitions invites any Trade Association or individual consumers who may have reason to complain of difficulty in obtaining supplies of iron or steel to seek the assistance of the Secretary of the Area Committee of their locality. Such complaints will be dealt with by the Area Committee, and, if necessary, representatives of the industry or firms concerned will be invited to attend a special meeting of the Committee. Appeal may if desired be made to the Central Steel Committee of the Ministry of Munitions.

The names and addresses of the secretaries are as follows :—

Scotland.—G. W. Langford, 105, West George Street, Glasgow.

N.E. Coast.—W. E. Bowles, North-Eastern Bank Chambers, Middlesbro'.

South Wales.—Henry Clement, 25/29, Royal Metal Exchange, Swansea.

Midlands.—D. J. Suter, Phœnix Buildings, Colmore Row, Birmingham.

Sheffield.—N. Thomas, Angel Hotel, Angel Street, Sheffield.

Manchester (including N. Wales and N.W. Coast).—G. Throssel, Victoria Buildings, 81, Mary's Gate, Manchester.

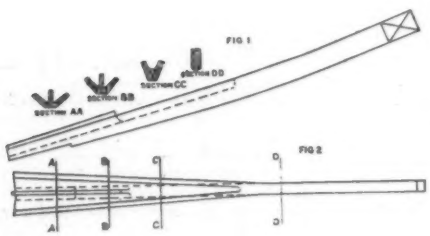
Consumers in London or localities outside the above areas should communicate direct with the Secretary, Central Steel Committee, Ministry of Munitions.

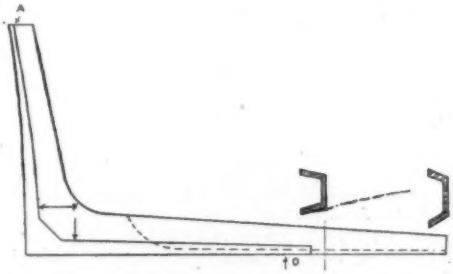
Castings Used in Ship Construction.

By Ben Shaw and James Edgar.

Stem Pieces.

There is considerable variety in the design of stem pieces, but the pattern-making and, indeed, the moulding also, is similar for all. The cross section is invariable U or V shape for the greater part of the length, but sometimes they are simply a straight or approximately straight length. As a general rule the smaller the ship the simpler is the design. They can be built on a flat if the centre line longitudinally is on the same plane throughout, which it generally is, except in the case of stem pieces for large battleships, when the design is frequently very awkward, necessitating an elaborate staging to support the portions of the pattern which are not on the floor level. As the principles of construction are the same for the former as for the latter types, it will be sufficient in this article to describe the pattern-making of three forms of stem pieces which are commonly used, and which comprise between them any difficulty which the pattern-maker or moulder is likely to encounter. These three forms are the straight piece shown in Figs. 1 and 2, the right-angled piece shown in Figs. 3 and 4, and the ram-nosed piece shown in Figs. 5 and 6.





Nearly all steel foundries prefer stem piece patterns to be exact counterparts of the casting. Their thickness is thus seen, and there is not the same possibility of a mistake as when core-boxes are used. In making patterns like this, where, apart from the sections given on the drawing, the craftsman has to use his own judgment in defining the shape, it is not an easy matter, even with the use of many templets, to get the core-box absolutely correct in relation to the pattern.

When the foundry is given a model of the casting the moulders can make drawbacks or cores, if necessary, to suit themselves. Of course, these remarks apply only to this class of large steel work. It would not be possible, even if it were wise, to adopt this practice in engine work. There are foundries, however, which insist on getting a solid pattern and core-boxes. This quickens the work in the foundry, but runs up the timber bill in the pattern-shop, which is a very serious matter at the present time, and is likely to be so for many years to come. If the cost of pattern-making is to be kept within reasonable bounds, lightness of construction must be more considered than it has been in the past, and foundries will have to adapt themselves accordingly.

We shall first consider the construction of a shell pattern for the plain type of stem piece, Figs. 1 and 2. Setting out the pattern on the floor (Fig. 7) is simple, care being taken to allow for contraction. It will be well to paint in half sections at the various places given on the drawing. Grounds like Fig. 8, about 1 in. thick, will have to be made for these sections and screwed to the floor, either by means of pocket screws or blocks, and it is these grounds that will assist in defining the contour of the pattern after it has been built and is lifted from the floor.

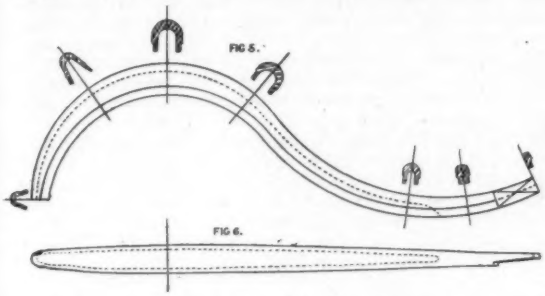
At first sight it would appear all right to bed a width of sufficiently thick timber on these grounds, and if the pattern were small, it would be done, but even then it would not be good practice, as even if dry timber were used, it would warp considerably. The best way, although the more expensive, is to build in layers about 1 in. thick, from end to end. Fig. 9 shows a cross section of the built work. It will be noticed that the bottom layers are laid down horizontally and the other vertically. Some may prefer to build them vertically right down to the joint. As the work tapers in thickness, the latter method is easier, but it has the disadvantage of having more feather-edge joints.

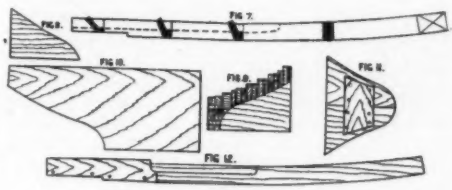
If the pattern is very long—say above 30 ft.—it would be a saving of timber to build in two or more lengths, interlacing them. Neither screws nor driving nails should be used when building, as even when the greatest care is exercised points will project and cause endless annoyance when finishing off. Besides which, it is not at all unusual for stem pieces to be altered in design after the pattern is completed. Good joints are essential, and screws may be used temporarily until the glue is set, when they should be taken out and wooden pegs inserted. When fitting the layers, it is essential to chalk or colour the grounds, because if a true shape is to be obtained, the layers must be well bedded at the various sections.

In some pattern-shops the solid end toward the scarph joints would be made from one width of timber, and the building in layers only started

beyond the end of the hollow, but it is difficult to bind the built portion to the other satsfactorily, and, all things considered, a better job is obtained by building in parallel layers from end to end.

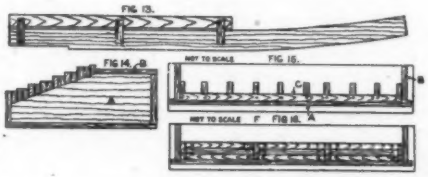
Having completed the building, the inside of the pattern can be left for a time. The outside shape is defined by templet, like Fig. 10. The edge, A, rests on the floor while the work is being tested. It is as important to cut the outside sections accurately as it is to bed the layers on the inner grounds accurately. It is not advisable to do more to the outside at this stage than cut the sections. It is more difficult to finish the inside than the outside; consequently, if the part inside be slightly under-cut, and the outside is unfinished, it is





possible to compensate for the discrepancy inside by leaving extra metal outside.

To expedite making the pattern, sometimes the two halves are made concurrently and shaped finally together, but it is better practice, and obviates the possibility of mistakes to build one half on the top of the other. The finished half pattern should be lifted off the ground and laid inside upon trestles. To support it in a convenient position is a simple matter. It is much easier building on trestles or on a bench than on the floor. Half grounds, similar to those used when building on

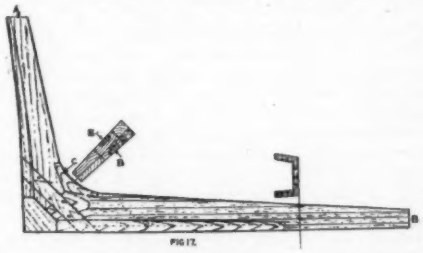


the floor, should be used for the top, and a batten, as shown at Fig. 11, will hold them together. When the top has been built similarly to the bottom, the positions of the given sections should be marked on the outside so that it can be lifted to the level floor, and the templet (Fig. 10) used for cutting the shape.

The only difference that may be made between the top and the bottom halves of the pattern is at the solid end. The moulder, when making his joint, will follow the top edge of the pattern up to the section D D, Fig. 2, so it is only necessary to build up to this section and glue and screw a single thickness on the remainder of the pattern. The pattern being completely built, it is possible to get more men at work finishing off. The inside should be shaped first, gouges and planes being used. A sensitive touch is of greater value in getting a good shape than the use of additional templets. It is wise, however, after the inside is finished to fit several templets, carefully marking the position. From these templets others can be made for the outside, the necessary thickness of metal being allowed for.

From Figs. 1 and 2 it will be seen that there is a rib in the centre of the stem piece; that is, on the joint of the pattern. It is also seen in Fig. 12, which is a view of the joint of the pattern. The best way to fasten it, both for strength and simplicity, is to cut a recess on the top and bottom halves of the pattern half the thickness of the rib, and screw it down the bottom. The moulder can unscrew it in the mould. If it is wide, a couple of hard-wood battens inset would prevent it warping. This completes the constructions of a shell pattern.

If a solid pattern is required for the above stem piece, the first task is to make two open-jointed plates, like Fig. 13. These plates should be made of the thickness shown at D D, Fig. 2, or, if this is greater than about 1¼ in., an additional thickness can be screwed on for this end, and the whole shaped off afterwards, as it is not necessary to build



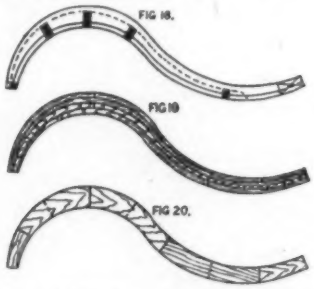
in layers beyond D D. A cross section of the pattern is shown in Fig. 14. The thickness of print required is very largely a matter of opinion. Some foundries are satisfied with a guide of an inch or two, while others insist on a wide print to balance the core. It is a matter for arrangement between pattern-shop and foundry before the job is started.

The shape of the ground, A, Fig. 14, can usually be determined from the floor drawing. If the line from A A to D D, Fig. 2, is concave instead of straight, it may be necessary to make the top plate of the print thicker than the front or back, the concave shape being cut before it is finally fastened on. Providing that good joints are made, it is not necessary for the portion of the pattern

which is built of layers to be more than 1 in. or 1¼ in. thick.

In making the core-box there is a choice of two methods, skeleton and solid. The labour cost for making the solid box is greater in the pattern shop, but the reverse is the case in the foundry. However, timber is the important item of consideration. Steel foundries nowadays invariably insist on solid patterns, but whether they are justified in insisting on solid core-boxes is very questionable. The ramming of a core-box is different from a mould, as steel moulds have to be very hard-rammed. A skeleton box can be easily and quickly filled with ashes and bits of stone or brick. Fig. 16 is a suitable skeleton box. It will be necessary, because of the changing shape, to make a full box. The bottom, back, and ends may be made of 1¼ in. timber, and if the bottom is wide it should be open-jointed and battened. The front should be left open, and the width of the back, A, and the ends, B, will be determined by the print. If the print is concave top and bottom, the bottom of the box, for convenience, may be made straight and a convex piece fitted in afterwards.

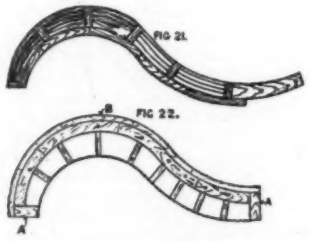
The ends of the box should be checked into the back. The top strip, C, may be about ¾ in. thick, so the shaped grounds will have to be made ¾ in. less than the total depth of the box to allow for



this. A ground should be inserted at each of the given sections, and to get the shape of the grounds between these, it is best to make templets from the pattern similar to the one illustrated, and make the core-box templet from this. The grounds should not be more than 3 in. or 4 in. apart. To make a solid box the method is similar to a print. When the given sections have been screwed into position, grounds for supporting staves should be fastened to them. These are shown by the dotted lines in Fig. 16. If possible, the faces of these grounds on which the staves will be fitted should be kept on the same plane, as this will simplify jointing the staves. Templets ought to be used at various points between the grounds to determine the shape. The work of shaping the box is considerable, but it is made easier by removing the ends temporarily.

The stem piece, Figs. 3 and 4, is awkward to make because of the leg, A. If care is not taken in the pattern-shop, an inaccurate casting may be obtained. There are two methods which may be employed to fasten the end A to the main length; either the one may be half-lapped into the other, or hard-wood batten (B, Fig. 17) may be inset, and the large corner fillet, C, fitted as a separate piece. Half-lapping is to be recommended if the stem is thick, but if it is thin probably the better way is that shown in the sketch. In making the length D, joint-plates are necessary. Towards the end these become very narrow, yet they bind the pattern together.

When these plates are finished, the leg can be jointed on. It is as well to keep the plate sufficiently thick so that the bevel can be planed off, because it will be noticed that the taper is irregular from end to end of the stem piece. The leg ought to be screwed in place, marked off, and then taken away to be finished. If it is very wide, battens ought to be checked into it. The method of building that part of the pattern which is hollow has already been described. The layers taper into the joint plate at E. In planing the outside of this pattern, it may be done either by erecting two guides on the floor, or, better still, by planing the long length first to the correct angle, then drawing a line on the end A and planing this through. The check piece F, which forms a recess for the plating, is fitted last. It assists, also, in binding the pattern. When both halves have been made, it is as well to screw them together, and screw on a long diagonal batten just clear of the ends A and B. The batten is not shown in the sketch. If a dowel-pin is put in at each end, the moulder can easily replace it when he draws the pattern, and it ensures the two legs always being in correct relation to each other. If a solid



pattern and core-box have to be made, the construction will be similar to that described for the stem piece shown in Figs. 1 and 2.

The ram-nosed type of stem piece is not very often seen now. From the pattern-maker's point of view it is not more difficult to make than the other forms, but it is clumsier. Fig. 18 shows the outline drawn on the floor, but instead of the various sections, the grounds on which the segments are built are shown. No rule can be laid down as to the length of the segments. This must be determined by the width of timber at hand. It is better to have shorter segments, and use the full width of timber than have a lot of waste. More care is necessary when shaping a circular pattern like this than with a straight length.

A view of the finished pattern is shown at Fig. 19. Considerably more labour is entailed if a solid pattern for a ram-nosed stem piece is wanted. Two joint plates like Fig. 20 have first to be made. They should be made by segments, as shown, about ⅞ in. or 1 in. thick. When they are cut to shape, grounds about 2 in. thick should be got out for the given sections. Between these grounds segments can be built. It is easier to do this than to build segments all the way without a proper guide.

It may be thought advisable, after the job is completely built, to fit grounds at each end of the segments to act as supports. This should be done,

of course, before the shape is finished. Making the print is not difficult. It is best to construct this also of segments, and the shape can be planed afterwards to points taken from Fig. 21. This is a pattern that lends itself to the skeleton method if the foundry can be persuaded to accept it.

We shall suppose for these jobs the foundry will be satisfied with a good skeleton core-box. When making a skeleton core-box it is always advisable to enclose the grounds with insides; that is to say, a box should be made first and then filled. This makes a strong core-box, and it is easier for the moulder to fill in than when the ends of the grounds are the outside of the box. To follow this procedure, however, in this case, a very great quantity of timber would be used, and in all probability one core would be all that would ever be wanted.

The cheapest effective box is shown in Fig. 22. The bottoms are made of two thicknesses of segments, like the joint-plates for the pattern. The shape of the core should be accurately drawn on the bottom, and one edge of the plates will form the inside of the box, which the moulder can strickle with a straight edge. Good strong ends, A A, may be screwed in position, and the grounds which will have to be made from templets transferred from the pattern and then got out and screwed firmly to the bottom. The top strip, B, will prevent them from either being broken or knocked over when the moulder is filling the interstices with brick and sand. It is better to complete one half of the core-box and then build the other on top of it. Dowels can be put into the ends. If the two halves are built separately, there are almost certain to be slight discrepancies when they are placed together. This box could be strengthened very considerably by a ring of segments screwed to the bottom plate against which the grounds would be fitted, and this might be advisable if a few cores were wanted.

The London Iron and Steel Exchange.

The directors of the London Iron and Steel Exchange, which opens on February 11 at the Cannon Street Hotel, recently invited a number of representatives of the daily and trade and technical Press to a luncheon to hear a statement of its aims from the Chairman, Mr. J. Whitby (Messrs. J. Summers & Sons, Limited).

Mr. Whitby, in explaining the objects of the Exchange, spoke as follows :—It is a peculiar fact that the City of London has hitherto not enjoyed the advantages which many provincial and Continental cities possess, in having a common meeting-place where those interested in the iron, steel and allied industries may meet together and transact their business. Many will say that such business can quite easily be carried on by correspondence, but the satisfaction which naturally ensues from personal contact with those interested in the same objective cannot be obtained by letter writing, however agreeably it may be conducted. Besides which the time taken, and very often the misunderstandings arising in correspondence, are obviated by being able to meet those with whom you wish to do business. The objects of the Exchange may be summarised briefly as follows :—(1) To provide, regulate and maintain a suitable meeting-place in the City of London for those engaged in the iron, steel and allied trades. (2) If necessary, to adjust controversies between the members of such Exchange. (3) To establish just and equitable principles in these trades. (4) To maintain uniformity in rules, regulations and usages. (5) To adjust standards of classification. (6) To disseminate useful information connected with the industry throughout all markets. (7) Generally to promote the interests of the iron, steel and allied industries. With these objects in view the directors have obtained the use of the Great Hall at the Cannon Street Hotel on every Tuesday from 1.30 to 4 p.m. The Exchange will be opened on Tuesday, February 11, at 2.30 p.m. by Sir Albert Stanley, the President of the Board of Trade, and I sincerely hope all you gentlemen will be present on that day.

As we have endeavoured to bring together all those connected with this vast and far-reaching industry, an industry which has more than any other helped to win this war, it became of paramount importance that the floor of the Exchange should be sub-divided in such a way as to provide an easy means of discovering buyers and sellers in a particular market. With this end in view the Exchange has been divided into eight sections bearing a number. Without knowing the actual number of subscribers in each section of the industry it is impossible to allocate the space available at this stage, but as a preliminary numbers will be placed on the walls of the Exchange and keys to the positions will be exhibited. The lay-out of the floor at present is as follows :—

(1) Ores, Pig-iron, Semi-finished Steel, Ferrous Alloys, Scrap Iron and Steel, Ingots, Blooms, Sheet Bars, Billets, Ferro-Manganese, etc.

(2) Iron and Steel Bars, etc.—Bars, Angles, Tees, Joists, Channels and Sectional Material generally. Hoops, Plates, Wire Rods, Wire, etc.

(3) Steel Sheets, etc.—Black and Galvanised Sheets, Tinplates, Terneplates, Black Plates, etc.

(4) Structural Iron and Steel Work, Machine Tools and General Machinery.

(5) Railway Material, etc.—Rails and Accessories, Rolling Stock, Portable Railways, Wagons, Bolts, Nuts, Rivets, Spikes, Chains, etc.

(6) Castings (Iron and Steel).—Gas and Water Pipes, Sewer Castings, Heavy, Light, etc.

(7) Hollowware, Hardware, Nails, Tools, etc., Builders' Hardware, Sanitary Ware, Heavy Hardware, Shelf Hardware, Ironmongery, Domestic Machinery, Small Tools, Agricultural Implements, etc.

(8) Non-ferrous Metals (manufactured and otherwise).—Aluminium, Antimony, Copper, Lead, Nickel, Spelter, Tin, Zinc Sheets, Copper and Brass Sheets, Tubes, etc.

From this lay-out it will be seen that an effort has been made to incorporate as far as possible all classes of the industry who are likely to benefit by becoming subscribers.

Another feature of the Exchange will be the use of what I will call, for want of a better term, Identification Badges. It must be obvious to all that in an Exchange of this nature where so many classes of a huge industry are about to meet together for probably the first time, considerable difficulty will be experienced in identifying those with whom one wishes to do business. To overcome this difficulty facilities have been arranged whereby subscribers may obtain, if they wish, a badge bearing their name and that of the company or firm they represent.

There are one or two points connected with the Rules of the Exchange to which I wish to draw particular attention. Unlike some Exchanges, it has been deemed advisable in this case to restrict those who may become subscribers to principals. The principals of a firm are, of course, the partners, but in the case of a limited company a director or an official authorised by such company to act as a principal may be elected as a subscriber. The annual subscription is three guineas for each representative, and there is, in addition, an entrance fee of three guineas for each representative, but the first 250 subscribers were exempt from the entrance fee. A subscriber may apply for an admission card for an authorised clerk, and the annual charge for such admission card is two guineas.

The Exchange will be managed by a Committee, who will be appointed as soon as possible after the opening.

Trade Talk.

THE BALL BEARINGS ORDER, 1917, dated November 1, 1917, has been suspended.

SNOWDON, SONS & COMPANY, LIMITED, have removed to 85, Gracechurch Street, London, E.C.3.

THE sale of the plant and machinery at the Keighley National Shell Factory realised £20,000.

DRAKE & GORHAM, LIMITED, have removed their offices in Manchester to 29, Piccadilly.

KENNEDY, BERRY & COMPANY, LIMITED, have removed to 88, Gracechurch Street, London, E.C.3.

THE annual meeting of the Institute of Marine Engineers will be held on Friday, March 28.

MR. A. JOSEPH, Earl Street, London Road, Southwark, London, S.E.1, has resumed the supply of solder and ingot lead.

HARLAND & WOLFF, LIMITED, are stated to have concluded negotiations for the purchase of the Portbury National Shipyard.

THE examination in bankruptcy of Messrs. Thomas Brown & Sons, Camm Foundry, Duns, will take place in Edinburgh on January 16.

MESSRS. H. B. BARNARD & SONS, Fenchurch Street, London, E.C., have appointed Mr. H. Jacobs as their agent for copper and spelter.

THE NATIONAL METAL AND CHEMICAL BANK, LIMITED, have acquired the share capital of the firm of Bessler, Waechter & Company, Limited.

ORDERS will shortly be placed by the Government for bricks and other material for use in connection with the Government housing scheme.

IN future Sir Joseph Jonas, Colver & Company, Limited, Continental and Novo Steel Works, Sheffield, will be known as Jonas & Colver, Limited.

A FIRE broke out on January 18, at the Albion Steel Works, Sheffield, of Matthias Spencer & Sons, Limited, but the damage was not particularly heavy.

A PROPOSAL is on foot to start another engineering works in Dundee. The site required extends to about 220 poles, and is situated in East Dock Street.

MESSRS. H. SHARROCK AND T. DOYLE, gas engineers, trading under the style of H. Sharrock & Company, 187, Kirkstall Road, Leeds, have dissolved partnership.

THE COVENTRY ENGINEERING ACCESSORIES COMPANY, LIMITED, is being wound up voluntarily, with Mr. C. B. Lee, 4, St. Anne's Road, Coventry, as liquidator.

THE MINISTRY OF MUNITIONS have ordered the plant and machinery at the Acton Shell Factory, Acton, W., to be offered for sale by auction at an early date.

MR. C. LEIGH, for many years chief chemist of the Birmingham Metal and Munitions Company, Limited, has been appointed general manager of Thermit, Limited.

CONSIDERABLE damage has been caused by an outbreak of fire which occurred at the premises of Messrs. Millen Bros., constructional engineers, Finnieston Street, Glasgow.

MR. S. R. DUNWOODY, 28, Budge Row, E.C., has been appointed liquidator of the Bushey Park Machine Works Company, Limited, which is being wound up voluntarily.

MESSRS. R. R. ENGLAND AND F. T. WALLISS, brass turners and casters, Turner Street, Sheffield, trading as England Brothers & Company, have dissolved partnership.

THE electric steel foundry of the National Steam Car Company, Limited, at Chelmsford, which has involved the company in losses from the start, has now been closed.

MR. L. C. HARVEY has established himself in business at 25, Victoria Street, London, S.W., as an advisory engineer in connection with furnace design, fuel economy, etc.

THE first meeting of the Manchester Metallurgical Society was held on January 30, when Mr. E. L. Rhead delivered an address on "Metallurgy and its Application to Industry."

A BRANCH has been established at Arcade Chambers, 89, Corporation Street, Birmingham, by Messrs. Brandeis, Goldschmidt & Company, 18 and 19, Fenchurch Street, London, E.C.

THE ETNA IRON & STEEL COMPANY, LIMITED, of Motherwell, have established their London office at 7, Union Court, Old Broad Street, E.C.2, under the management of Mr. T. F. Jemmett.

THE shipbuilding yard of Messrs. McLaren Brothers, Dumbarton, was seriously damaged by fire last month. Damage was also done to an adjacent shipyard occupied by Messrs. McMillan & Company.

MR. A. W. BAINBRIDGE, late of Messrs. Braithwaite & Company, has been appointed the London agent of the Lanarkshire Steel Company, Limited, London House, New London Street, E.C.

THE Government propose disposing of the National Ordnance Factory, High Church Street, New Basford, Notts., and the National Filling Factory (No. 24) Balmoral Road, Watford, Herts.

MR. T. W. WILLIS, the president of the Sheffield Society of Engineers and Metallurgists, gave his presidential address at a meeting of the Society, held at the Applied Science Department of the University on January 27.

MR. JOSEPH OXLEY, iron, steel, and machinery merchant, Cadman Chambers, Norfolk Street, Sheffield, has acquired the Allenby Works, Spring Street, Sheffield, of Mr. A. J. Holling, and it is his intention to continue the business as hitherto.

MR. M. L. SIMPSON presided at a meeting of the West of Scotland Iron and Steel Institute, held in the Royal Technical College, Glasgow, last month, when a paper on "The Solid and Liquid States of Steel" was read by Mr. Cosmo Johns.

With the general release from Government control of raw materials used in industry, the necessity for rationing disappears, and the Civil Industries Committee, through whom that rationing has been exercised, is now disbanded.

MAJOR JAMES CALDWELL has resumed his position in the firm of Messrs. J. E. Sayers & Caldwell, Ocean Buildings, 190, West George Street, Glasgow, and has established himself in London at Parliament Mansions, Victoria Street, London, S.W.1.

THE maximum prices for calcium carbide have been amended, and in future for quantities of 110 lbs. and over, exclusive of carriage charges, the prices will be £30 per ton for lump sizes and £30 10s. per ton for granulated sizes up to 15/25 m.m.

THE GLASGOW STEEL ROOFING COMPANY, LIMITED, Possilpark, have decided to erect an institute as a war memorial. The institute will be provided by the company on their own grounds, and will be organised and operated by the workers as a social club.

THE Government have decided to dispose of the National Rifle Factory (No. 2), Garrison Lane, Birmingham. The area of land is about 3a. 0r. 10p., and the area of the buildings (ground floor) 43,840 super feet, with 6,000 square yards available for extension.

THE following have been transferred from (A) in the list of British prohibited exports :—(B) Boiler tubes; (B) carborundum, alundum, crystolen, and all other artificial abrasives and manufactures thereof; (B) iron pipes (wrought); (B) iron tubes; (B) steel tubes.

THE partnership heretofore subsisting between Messrs. D. C. Young and A. E. Joslyn, civil engineers and metal brokers, 41, Wind Street, Swansea, under the style of Duncan C. Young & Company, has been dissolved. Mr. A. E. Joslyn will continue the business in his own name.

THE shareholders of the Vulcan Foundry Company, Limited, met last month to consider a resolution to increase the capital to £1,000,000 by the creation of 400,000 new shares of £1 each. It is proposed to extend the works in view of the anticipated demand for locomotives.

IT is understood that, as the outcome of a deputation of leading British manufacturers, which waited upon the President of the Board of Trade, on January

16, an influential committee is about to be formed to advise the department as to restrictions on the importation of goods of foreign origin.

MESSRS. W. R. WILLIAMS & COMPANY, steel and tool manufacturers and merchants, 23, Wilson Street, Finsbury, London, E.C.2, have taken up the sole London and export selling agency for hacksaw blades made by the Sheffield and Hallamshire Hacksaw Company, Limited, London Works, Bridge Street, Sheffield.

THE Minister of Munitions has issued notice that the export prices for pig-iron, finished iron and steel are for net cash against documents, and are not intended to include any provision for extended credit. In the event of credit being given, additions may be made to the prices to cover the credit at a reasonable rate of interest.

THE "Gazette" notifies the revocation of the following Defence of the Realm Regulations:—8E.—Power to regulate and restrict building and construction work. 15.—Power to require census of goods. 30B.—Prohibiting certain dealings in metals. 34B.—Power of Minister of Labour to refer, in certain cases, trade disputes to a single arbitrator.

AT the College of Technology, Manchester, on December 27, an exhibition was opened of British scientific products, illustrating new developments in the engineering, textile, chemical, glassware, silica ware, porcelain, scientific instrument, airplane, and other industries, which have been largely developed in this country during the period of the war.

THE price at which the Government are prepared to sell their stock of aluminium has been reduced to £150 per ton for 98/99 per cent. ingot, at which price steps have been taken to stabilise the market. Arrangements have been made in regard to these stocks that they shall be disposed of in such a way as to avoid dislocation in the aluminium industry.

MESSRS. DONALDSON BROTHERS have placed with Scotts' Shipbuilding and Engineering Company, Limited, Greenock, an order for four cargo steamers of 9,000 tons deadweight carrying capacity each. The Anchor-Donaldson Line are reported to have placed an order with the Fairfield Shipbuilding and Engineering Company, Limited, Govan, for two large steamers.

FERGUSON, PAILIN & COMPANY, LIMITED, 55, Market Street, Manchester, in connection with the very considerable extension of their business, have found it necessary to reconstruct and to transfer the goodwill and assets of the existing business to a new company to be called Ferguson Pailin, Limited. This involves, for technical reasons, a voluntary liquidation of Ferguson, Pailin & Company, Limited.

A NUMBER of obsolete tanks are to be sold by the Government. The intention is that they should be broken up, and the material, including engines and gears, used for industrial purposes. Inquiries in connection with the matter should be addressed in the first instance to the Secretary, Committee on the Utilisation of Surplus War Material, Room 211, Armament Buildings, Whitehall, S.W.1.

M. LEON GREINER, a director of the Cockerill Works, and a son of the late M. Adolphe Greiner, has lately been in London on business connected with the restoration of the Seraing works. M. Greiner estimates that at existing prices it will cost £2,000,000 and take three years to make good the damage. It appears that only two out of seven blast furnaces are left, and only two out of eleven rolling mills.

THE average net selling price of No. 3 Cleveland pig-iron for October, November, and December, 1918, is certified at 118s. 6.21d. per ton, as compared with 118s. 10.86d. for the previous quarter. This means a reduction in blast-furnacemen's wages of .5 per cent., which brings wages from 108.5 per cent. above the standard to 108 per cent. above the standard. The foregoing prices of pig-iron include the subsidy.

THE "Aisne" and "Ypres" National Projectile Factories at Renfrew are being offered for sale by the Government. The latter stands on a site of 6a. 2r. 8p., and contains a ground area of 107,298 sq. ft., and the "Aisne" stands on a site of 10a. 1r. 16p., with a ground area of 106,763 sq. ft. The plant, machinery, etc., at the National Shell Factory, Dalton Lane, Keighley, was offered for sale by auction on January 21.

NEGOTIATIONS have now been completed by which Baldwins, Limited, will take over the undertaking of the British Steel Corporation, Limited, which was registered last October with a capital of £1,000,000 in £1 shares. This corporation, it will be remembered, acquired the Briton Ferry Works and a site of 350 acres situated between the Swansea Docks and the Neath River. It is stated that Baldwins, Limited, have decided upon an issue of £1,000,000 of new preference shares.

AN open general licence has been issued permitting the exportation of railway carriages, locomotives, and wagons and their component parts to all destinations except destinations in European or Asiatic Russia, and in other foreign countries in Europe or on the Mediterranean Sea other than France and French Possessions, Italy and Italian Possessions, Belgium, Portugal, Spain, Greece, Morocco, Palestine, and Syria, as far north as a line from Alexandretta to Aleppo inclusive, and as far east as the Hejaz Railway inclusive.

THE annual report of the Industrial Reconstruction Council claims that great success has attended the Council's efforts. Joint bodies have been elected in the following trades:—Blacksmiths and farriers, bobbin and shuttlemaking, brass and copper, building, cable-making, cement, chain-making, chemicals (heavy), commercial road transport, cutlery, electrical contracting, electricity, power and supply, hollow-ware (wrought), iron and steel trades, lock, safe and latch, metallic bedsteads, and patent fuel.

THE Government have decided to dispose of the national projectile factory at Birtley. The buildings cover an area of 541,602 sq. ft., all ground floor. There are over 40 sidings, with a total length of 27,458 ft.; four loading platforms, and a large number of overhead travelling cranes. There is office accommodation for 234 clerks, and messroom accommodation for 350 persons. The area of the land upon which the factory stands is 52 acres, 3 rods, 14 poles. The area of the main shell-shops is 135,207 and 134,428 sq. ft. respectively, and of the bond store 83,509 sq. ft.

THE SECRETARY OF THE SOCIETY OF CHEMICAL INDUSTRY is drawing the attention of members to the newly-formed Chemical Engineering Group of the Society. Some 800 members have promised membership of the Group. A sub-committee appointed by the Council met the Provisional Committee of the Group, and, after discussion, decided to recommend the Council to accept the principle of the establishment of Subject Groups, of which the Chemical Engineering Group would be the first, and this recommendation was adopted by the Council at its meeting on October 24 last.

THE following headings have been deleted from the list of prohibited exports:—(A) Cobaltchrom and similar alloys; (B) drawplates, jewelled, for drawing wire; (B) ferro-manganese; (B) ferro-titanium; (B) ferro-silicon; (B) manganese and manganese ore; (B) nickel, its ores and alloys; (B) sacks, coal; (B) selenium; (B) silicon-manganese; (B) spiegeleisen; (B) thorium and its alloys; (A) titanium, alloys of titanium, and titanium ores; (A) tungsten alloys; (A) tungsten (except tungsten filaments for electric lamps); (B) tungsten ores (including ferberite, hubnerite, scheelite, and wolframite); (A) wire, barbed: (A) wire, galvanised.

THE BOARD OF TRADE draw the attention of all companies, firms, and individuals dealing in non-ferrous metals to section 10 (2) of the Non-Ferrous Metals Industry Act, 1918, which provides that the Act shall continue in force for a period of five years after the termination of the war. The provisions of the Act are in no way affected by the relaxation of the control over certain non-ferrous metals exercised by the Ministry of Munitions during the war; and it is still necessary for companies, firms, and individuals doing

business of a kind to which the Act applies to be licensed by the Board of Trade.

THE SHIPPING CONTROLLER announces that the national shipyards, the construction of which was undertaken as a war emergency measure, are, in view of the armistice, being finished off on a reduced scale, all measures being taken to protect the value of the property with a view to securing that it realises a fair value eventually as a going concern. Individuals or firms who are prepared to submit proposals for the acquisition and operation of the yards should communicate with the Secretary, Ministry of Shipping, stating how far they are prepared to enlist the co-operation of labour by the adoption of the co-partnership principle or otherwise.

THE membership of the Federation of British Industries now comprises 163 trade associations, 15 associations of controlled establishments, and 822 firms, making a total of 1,000. The latest additions are the Brassfounders' Employers' Association, 110, Edmund Street, Birmingham; the British Gas and Oil Engine Manufacturers' Association, 36, Kingsway, W.C.2; the Midland Forgemasters' Association, 45, Bank Street, Sheffield; the Sheffield Cutlery Manufacturers' Association, High Street, Sheffield; Glenfield & Kennedy, Limited, Kilmarnock; Ludlow Bros. (1913), Limited, Birmingham; and Westley Richards & Company, Limited, Birmingham.

THE MINISTRY OF MUNITIONS have available for disposal a considerable quantity of plant of various descriptions, hitherto used in the manufacture of munitions, and which may be useful for the ordinary trade of the country. Firms wishing to avail themselves of the opportunity to purchase any portions of this plant should, in the first instance, apply to the Superintendent Engineer of their districts. The Ministry also has for disposal limited quantities of non-ferrous scrap metals, at the following prices:—Heavy scrap brass, £70 per ton; Q.F. cartridge cases, £81 per ton; heavy copper scrap, £94 per ton; clean H.C. wire, £96 per ton; heavy scrap lead, £33 per ton.

THE BISMUTH ORDER, 1918, has been amended so as to remove the obligations contained in Clause 2 (5) upon every person who uses bismuth metal or alloy to make returns to the Controller of Non-Ferrous Material Supply, and by enlarging the class of persons exempted by Clause 2 (6) from the necessity of making returns. Clause 2 (6) will in future read as follows:—(6) "Notwithstanding the above, no return is required from any person whose total stock in hand and not intended to be used in connection with the manufacture or alloy of steel or other metal has not, during the period for which a return would, but for this exception, have been required, exceeded, in the case of Bismuth Metal or any alloy thereof, 56 lbs."

THE officials and foremen of John Brown & Company, Limited, Clydebank, were entertained at luncheon in the works last month by the directors of the company. Opportunity was taken after the luncheon to welcome back to Clydebank their chief—Sir Thomas Bell, K.B.E.—who had been engaged at the Admiralty for 19 months as Deputy Controller of Dockyards and Naval Shipbuilding. Mr. W. J. Luke, C.B.E., presided, supported by the local board and the leading foremen and officials. In recognition of his services at the Admiralty, and also of the honour conferred on him by His Majesty during his absence from Clydebank, two presentations were made to Sir Thomas Bell—a silver salver by the foremen and a rose bowl and candelabra by the officials.

AT the inaugural meeting of the Sheffield Section of the Institute of Metals, held on January 24, a report was presented in which were incorporated the rules of the Section, together with a proposal that the Society of Applied Metallurgy should now cease to exist. Mr. W. R. Barclay was elected the first chairman of the Section, and it was decided to accept an offer to make the University its headquarters. Mr. B. Brook was elected secretary, Mr. E. Smith vice-chairman, Dr. R. S. Hutton, past chairman, and Mr. H. Turner treasurer. The committee was elected as follows:—Dr. Thompson and Messrs. Kent Smith, F. Mason, W. G. Turner, H. J. Taylor and E. H. Hill. Dr. H. C. H. Carpenter, the president of the Institute of Metals, gave the inaugural address, in the course of which he defined the objects of the Institute, and showed how they were achieved, and the relation of the local sections to the parent body.

THERE is every possibility of the staff at Woolwich Arsenal being maintained in the future at larger than pre-war strength. More difficulty is being experienced in finding work for women than for men. However, negotiations for work on clothing repairs, gas-masks, etc., are at present proceeding, and it is hoped that something can be arranged for the women on those lines. With reference to men, a suggestion for work in connection with the reconstruction of Belgium is being followed up, but at present nothing definite has been settled. Investigation is being made into the question of engineering work required for the Port of London Authority, which, it is suggested, can be done at the Arsenal. Further, it has been decided to go on with the construction of locomotives at Woolwich, and a preliminary order for 100 has been placed. In connection with the Government's new housing programme, a provisional order for 20,000 doors is being placed with the Arsenal.

THE RAMSAY MEMORIAL COMMITTEE, in the appeal for a sum of £100,000 issued in June, 1917, stated as one of the two principal objects to which the larger part of the fund would be devoted, the establishment of a Ramsay Memorial Laboratory of Chemical Engineering in connection with University College, London. The object of the laboratory would be to give an engineering training to chemists. Consequently the new laboratory would be in close connection as regards location, staff, and curriculum with the Engineering Department of University College, London. It is provisionally estimated that such a laboratory could be erected for about £20,000; that the equipment could be provided for a sum of £10,000; that accordingly, if a total sum of £50,000, being one-half of the Ramsay Fund, were allotted to this object, there would be £20,000, representing an income of about £1,000 per annum, available as an endowment fund for upkeep, salaries, etc. The Committee are now appealing for the completion of the fund, a generous response having already been made.

THE amalgamation is announced of the firms of David Colville & Sons, Limited, and Harland & Wolff, Limited, marking a further step towards the fusion of allied trades, in this instance iron, steel, coal and shipbuilding. It will be remembered that last year Messrs. Colville acquired a controlling interest in the firm of Archibald Russell, Limited, coalmasters. David Colville & Sons, Limited, was registered as a limited liability company in 1895 to carry on the business of steel and iron manufacturers, and has acquired the undertakings of the Glengarnock Iron and Steel Company, Limited, the Glengarnock Chemical Company, Limited, and the Clyde Bridge Steel Company, Limited, while, as already stated, a controlling interest has been secured in Archibald Russell, Limited. The capital of the company is £1,350,000. Harland & Wolff, Limited, was registered in 1885, and in 1912 the entire share capital of the London & Glasgow Engineering & Iron Shipbuilding Company, Limited, was acquired. Afterwards, two neighbouring shipyard sites were also taken over, and later the firm acquired the Greenock works of Messrs. Caird & Company, shipbuilders and engineers. The authorised capital of the company is £1,600,000.

THE shareholders of the United Steel Companies, Limited, met at Sheffield on January 27, to pass resolutions increasing the capital to £8,930,000 by the creation of 1,250,000 £1 ordinary shares. In the course of a circular addressed to the shareholders the directors state:—In pursuance of the policy of the board ensuring economical and certain production by the acquisition of sources of home supply of the highest class of

hematite iron ore, and of acquiring additional blast furnaces adjacent to such iron ore, the company has recently acquired the whole of the issued share capital of the Distington Hematite Iron Company, Limited, and the remainder of the issued capital of the Beckermet Mining Company, Limited, not previously held by the company. In addition, the company has purchased and acquired the remaining half of the capital of the Appleby Iron Company, Limited, and other interests. The directors have also found that the extensions at various works belonging to the company, carried out under the directions of the Ministry of Munitions, need further capital. The directors therefore propose that the further capital required should be provided by an issue of 1,250,000 new ordinary shares of £1 each, ranking pari passu with the existing ordinary shares. These shares it is intended to offer to the ordinary shareholders, in the first instance, at a premium of 5s. per share, with the right of renunciation in favour of nominees and the right to apply for any surplus shares not taken up by the shareholders.

THE total area acquired for the purpose of the National Factory at Gretna is 9,200 acres, of which 2,800 are guarded by fences and sentries; 620 acres more contain the townships in which the factory workers are housed; and the remainder of the ground is devoted to agriculture and general service. The site had many advantages Three railways, the North British, Caledonian, and Glasgow and South-Western run through or close beside it, while eight miles away is Carlisle, where eight railways meet. Construction was commenced in the autumn of 1915, the works costing over £10,000,000. Directly operations were started cordite was turned out at a great reduction on the price which we had been paying in America, not to mention the cost of bringing the American cordite to Europe. The factory system includes seventy-eight miles of ordinary broad-guage railway track and forty-seven miles of 2-ft. guage. There are twenty locomotives of the ordinary type and fourteen fireless locomotives. The water for the factory is obtained from the Esk at a point 5½ miles distant. It is brought by 33-in. pipes to the waterworks, where it is filtered and supplied at the rate of ten million gallons daily over the whole area. The power station plant has a capacity of 10,500 kw. There is a central kitchen capable of cooking meals for 14,000 people daily. The adjacent bakery is capable of 13,000 loaves daily, while the laundry can wash 6,000 articles daily. There is a hall capable of seating 1,100 people, another holding 650, and two cinema halls hold 1,100 between them. The institute is complete with reading rooms and rooms for games, and there are tennis courts, etc.

AT an executive council meeting of the British Federation of Iron, Steel, Tinplate and Metal Merchants, held on January 14, the following resolution regarding the Government's Imports and Exports (Temporary Control) Bill was passed:—"That this council whilst admitting that certain raw materials and food produce may have to remain under Government control for a period after the war, strongly protests against any re-introduction of the Imports and Exports (Temporary Control) Bill as drafted and presented to the late Parliament, which proposed to give H.M. Government power to control import and export trade for a period of three years after the war by means of licences. Further, the council would urge that if manifold restrictions to export of manufactures are continued in this country, the products of other countries will surely become largely established in our pre-war markets, besides which British traders will be precluded from competing on terms of equality with those of neutral and lately allied countries. The council therefore records its strong opinion that (1) so far as exportation or re-exportation of any raw material necessary to the welfare of British industries are concerned, the same may be regulated from time to time by orders of Council on the recommendations of the Board of Trade, after taking counsel with the various associations of merchants and manufacturers interested therein. (2) In national trade interests, no legislation for control of trade in any way should exceed a permissive period of 12 months after the war. (3) Except for raw materials and food, the control to be exercised should be limited to trade with any country which has been an enemy one during the late war."

AT the request of the Government considerable extensions were made to the works of Cammell, Laird & Company, Limited, Sheffield, during the war, in order to assist in coping with the great demand for war material. When the Army called for an enormous increase in the supply of high explosive shells, the company was consulted by the Government and undertook the design, erection and management of one of the largest national factories. This was put down at Nottingham in record time with a completeness and organisation which earned the highest encomiums of the authorities. The greatest weekly output was 13,500 6-in. and 5,000 9.2-in. high explosive shells complete, ready for filling. When a greater output of guns became necessary the factory was selected for this work, and was rapidly transformed to execute the repair of damaged guns and the building of new ones. Messrs. Cammell, Laird were also invited to take measures to meet the enormously increased demand for steel. They therefore erected an extensive new steel plant, covering 36 acres, alongside their existing works at Penistone, near Sheffield, which comprises six 60-ton open hearth melting furnaces, and, at the same time, remodelled the adjacent rolling mills, etc. In addition to other products, the manufacture of autoclaves for use in connection with dyes and high explosives was undertaken with successful results. Previous to the war autoclaves came from Germany. Owing to the successful work which Messrs. Cammell, Laird had done in the way of heat treatment of gun steel, the Ministry of Munitions requested them to undertake a large extension of their Cyclops Works solely for the heat treatment, not only of gun forgings made by themselves, but also those produced by other firms in the locality. This plant dealt with as many as 1,700 gun forgings in a single month.

AMONG those present at the annual dinner of the Keighley Association of Engineers, held on January 4, Mr. H. Widdop presiding, were Sir Herbert Austin, M.P., Mr. Robert Clough, M.P., the Mayor (Mr. F. N. Binns), Sir Harry Smith, K.B.E., and others. In proposing "The Visitors," Mr. Walter Slingsby (ex-president) welcomed especially Sir Herbert Austin, K.B.E., M.P., as one of the eminent engineers whose researches before the war had been of inestimable value in the winning of it; and Mr. Robert Clough, M.P., who now represented the Keighley constituency. Sir Herbert Austin, in his reply, referred specially to the production of machine tools, and said that the builders needed better methods and more efficiency, and the question of improved design lay at the root of the position. Their Queen Anne and George IV. patterns must be thrown aside He had ventured to suggest to a representative of a Government Department a plan whereby financial support for a certain period might be given to machine tool concerns, equipped with the best machinery, to encourage home production, the local engineering association firms to decide what machines given workshops should make. He did not know what notice would be taken of his suggestions, but, at all events, from the starting point of good design, they should go on to realise the importance of specialising, and, above all, of self-reliance. He would give ten guineas if nine others would do the like, in order to offer a prize of 100 guineas for the best design of a "Keighley" all-geared 8½-in. head lathe made by a member of the Association. The offer was at once taken up, Sir Harry Smith, Mr. Arthur Smith, Mr. Slingsby, Mr. R. Clough, M.P., Mr. A. Sellers, Mr. Baldwin, Mr. J. Judson, Mr. Widdop, the Mayor, and Mr. Haggas completing the list.

Sir John McLaren, speaking at a meeting of the council of the Leeds Chamber of Commerce, on January 28, commented upon the future use of National Ordnance Factories, and Sir Albert Stanley's statement that the Government had no intention of entering into a manufacturing business in which it was necessary to organise a sales department. Sir John remarked that a suggestion had appeared in a section of the press that the National Ordnance Factories might be utilised for the manufacture of such things as locomotives, marine engines, and electrical machinery. People who made such suggestions did not understand what they were talking about, for the buildings were not suitable for the purposes suggested. If they were adapted for that work, the machinery was not suitable. Probably 90 per cent. of the machinery was built for the one purpose of shell and gun production, and very often for only one operation in that production. But the suggestions were put forward, and some papers were foolish enough to print them, and people felt that the suggestions were quite plausible. So far as locomotives were concerned, there was not a munitions factory in existence which had a boiler shop—one of the principal items in the construction of locomotives. It meant that the necessary machinery would have to be purchased and put into unsuitable buildings, and a more absurd suggestion could not be made. A highly technical staff and a sales organisation would also be wanted. Furthermore, if a railway company, say in South America, wanted 100 locomotives, representing some two hundred or three hundred thousand pounds, they were not going to place that order with a firm that had been converted from a shell factory, and had never done anything of the kind before. Such arguments applied equally to the production of electrical machinery and marine engines. The latter production must take place in the vicinity of the yards where the ships were constructed.

In its summing up of the effect of existing industrial and social conditions upon the present and future possibilities of adult education, the Committee on Adult Education makes the following recommendations on educational grounds:—(*a*) That there should be a general shortening by law of the normal working day, and that, subject to qualifications in the case of certain industries such as agriculture, it should not be more than eight hours. (*b*) That in heavy and exhausting kinds of work and work accompanied by special disabilities, the maximum legal working day should be shorter than the normal. (*c*) That overtime should be more closely regulated by law and reduced to a minimum. (*d*) That where "shift" work continues the hours should be reduced below those of the normal working-day; and that, except where it is absolutely essential, regular night work should be prohibited by law. (*e*) That efforts should be made to meet the evil effects of monotonous labour by alternating forms of employment, by creating opportunities for the exercise of initiative, and by establishing works committees for the consideration of matters affecting workshop life. (*f*) That steps should be taken to guarantee to the worker some reasonable security of livelihood either by such a reorganisation of industry as may prevent or minimise fluctuations in the volume of production, or, where that is impossible, by some extension of the principle of insurance. (*g*) That wage-earners should be entitled by law to an annual holiday with pay; and that the weekly half-holiday should be extended by law to the worker in agriculture. (*h*) That the preparation of schemes of housing and town-planning should be accelerated; that such schemes should be drawn up in consultation with the best expert advice available, and in co-operation with representatives of the people for whom such schemes are intended, and particularly representatives of women. (*i*) That adequate washing facilities should be required to be provided in all places of employment where the nature of the work makes it desirable. (*j*) That special consideration should be given to the peculiar problems of rural housing. (*k*) That a village institute, or at least a hall, should be established in every village under public control.

Government Metal Stocks.

In order that the trade may know the position in regard to stocks of the important metals, the following particulars are published by the Ministry of Munitions of the stocks (exclusive of old metals and scrap) in this country in the possession of the Minister of Munitions on January 1 and February 1, 1919:—

	Jan. 1. Tons.	Feb. 1. Tons.
Copper	36,000	41,882
Spelter, G.O.B. ...	22,273	23,905
Spelter, refined ...	8,017	7,234
Aluminium	11,957	13,092
Soft pig lead	62,852	86,493
Nickel	2,096	2,388
Antimony regulus ...	3,508	3,731

In addition to the above, the Minister holds large quantities of scrap, mainly brass, of which it is impossible to give any particulars at present. It is intended to publish at monthly intervals the stocks held on the first day of each month.

Deaths.

Mr. H. T. Stephenson, of the Vauxhall Foundry, Skirbeck, has died as the result of an accident.

The death is reported of Mr. Gordon Lenox, J.P., of Brown, Lenox & Company, Limited, engineers, etc., Pontypridd.

The death occurred at Edinburgh recently of Mr. E. Davies, late managing director of the Pather Iron & Steel Company, Limited.

The death has taken place at his residence, Riverdale Road, Sheffield, of Mr. A. Carlisle, a member of the firm of Messrs. Lockwood & Carlisle, engineers, Stalker Lees Road.

The death is announced of Lieut.-Col. John Rodgers, chairman and managing director of Joseph Rodgers & Sons, Limited, cutlery manufacturers, Sheffield, at the age of 62 years.

The death took place on January 12, at Culvers, Borstall Hill, Whitstable, of Mr. George Hagger, for 24 years secretary of Greenwood & Batley, Limited, and the King's Norton Metal Company, Limited, aged 74.

The death has occurred at his residence, St. Hellier's, Hermitage Gardens, Edinburgh, of Mr. J. H. Bennet, managing director of the firm of Alder & Mackay, Limited, gas-meter manufacturers, Edinburgh.

A well-known figure in Sheffield business circles is removed by the death of Mr. J. R. Heckley, who died at his residence, 90, Ashdell Road, on January 3, at the age of 72 years. The deceased gentleman would have completed his half-century's service with Vickers, Limited, next month.

The death is announced from Berlin, at the age of 80 years, of Herr Hubert Otto, a leading German metallurgist. The deceased was originally connected with the Redenhutte in Upper Silesia, and later with the Lauchhammer Gesellschaft, of Riesa-am-Elbe, and the Krupp Company, of Essen.

Captain A. Gemmell, Royal Engineers, son of Professor G. H. Gemmell, of the firm of Messrs. Readman & Gemmell, analytical chemists, Edinburgh, died recently. Captain Gemmell graduated at Edinburgh University, and for two years was assistant to the Professor of Chemistry. He then joined his father in business, but after the war broke out he rejoined the University O.T.C. He was transferred to the Anti-Gas Department, University College, London, where he carried on research work, which, however, undermined his health.

Legal.

Graphite for Krupps.

Lord Sterndale, in the Prize Court, has condemned as prize the balance of proceeds of 36 cases of graphite sold by Arthur Bramwell & Company, Limited, of London, to Krupps, and shipped at Colombo on the British steamship "Nyanza," which put into London in the July before the war broke out. The shipment was for Antwerp. Messrs. Bramwell & Company had not been paid, and they obtained an order from Mr. Justice Younger vesting the goods in the Public Trustee. The latter appointed Messrs. Bramwell & Company agents for sale; they were duly paid, and the Prize Court was asked to condemn the balance.

J. G. Stein & Co. v. Ministry of Munitions.

Last month the House of Lords dismissed the appeal of John G. Stein & Company, Limited, Bonnybridge, from a decision of the Second Division of the Court of Session upholding an award made by Lord Hunter as arbiter in a dispute between the appellants and the Ministry of Munitions as to the price to be paid for firebricks when the Department in 1916 required that the whole output of the country should be placed at its disposal. The appellants claimed that instead of 110s. per thousand, the Department should pay the same price, 120s. per thousand, as was paid to a rival Glenboig firm. The arbiter decided against the appellants and declined to grant a diligence of recovery, under which access would have been given to the books of the rival firm. It was on this refusal to grant a diligence that the appeal turned.

Lord Buckmaster, who presided, said it appeared to be wholly irrelevant at what price the Glenboig company had sold their bricks either before the war or to the Ministry of Munitions; and it would have been most unfortunate if, in the course of the experience they had gone through during the last four years, any Government Department that had appeared to have allowed a price that was too generous to a person whose output they controlled, was, therefore, compelled to allow the same high price to other persons who supplied a product of the same character.

Lords Finlay, Dunedin, Atkinson and Shaw concurred, and the appeal was dismissed.

Brown v. British Abrasive Wheel Company.

In the Chancery Division, on January 24, an injunction was moved for on behalf of Mr. T. B. Brown, of Coventry, against the British Abrasive Wheel Company, Limited, and the three directors of the company—Mr. W. L. Bayley, Mr. H. Walker, and Mr. P. Martin. The plaintiff complained that the directors had convened a meeting of the company to pass a resolution to alter the articles of association so as to provide that a shareholder of the company should be bound upon the request in writing by the holders of nine-tenths of the issued shares to sell and transfer his shares to the nominee of these holders. The case stood over till February 21, to allow further evidence to be submitted.

"Snowballing" in Foundry Companies.

The Birmingham Stipendary was occupied on January 28 and 29 in hearing charges of conspiracy alleged in connection with a series of foundry companies The concerns had been formed in succession to each other over a period of thirty years, and the transactions in question nearly all related to scrap metal and pig-iron. The defendants were H. C. Harvey, and his two sons, H. Harvey and E. K. Harvey.

For the prosecution it was explained that the three defendants were arrested on a charge of conspiracy for having defrauded various persons by divers subtle devices in obtaining goods on credit without payment. The prosecutors were Messrs. Grant Brothers, metal dealers, of Ventnor, Isle of Wight. Counsel said the system of trading carried on over a long term of years was nothing less than a fraudulent device for obtaining goods without any intention of paying for them. The plan was to form a company for which debentures were registered to acquire goods, and then when creditors pressed for payment they as the debenture holders were in a position to seize all the assets, including the goods not paid for. In some cases a receiver was appointed, but in others the debenture holder acted without a receiver, and then transferred the assets to a new company which had previously been formed, or which was shortly to be formed. In some cases there had been interpleader suits, but invariably the debenture holders succeeded. Usually the goods were obtained from a distance, their goods coming from Ipswich, Newcastle-on-Tyne, South Wales, Herefordshire, and elsewhere. These people having no knowledge of their methods of doing business were easily drawn into the trap. They would order a truck of scrap metal, occasionally paying for the first truck. Then they would order three or four more trucks, which would not be paid for. The frauds went as far back as the year 1888, when the elder Harvey was a works manager for Morris & Company. They started their first business with a small foundry concern bought from two working men, and traded as Harvey & Company. In 1899, on the petition of Morris & Company, to whom the Harveys owed money, the elder Harvey was adjudicated bankrupt, and remained undischarged until 1909.

Counsel proceeded to give the history of the establishment of a succession of companies during the intervening years. They included the Star Foundry Company, Limited, Aston Cross Foundry Company, Limited, Harvey & Friend, Limited, Harvey Stevens & Company, Limited, Harvey Son & Company, Limited, Harvey & Whitehouse, Limited, Aston Cross Foundry & Ironworks Company, Limited, H. C. Harvey & Company, Limited, Harvey & Stevens, etc. The Star Foundry Company, Limited, which was incorporated in 1897, had a capital of £2,000 in 2,000 shares. In 1899 it was wound up by order of the Court, and an investigation took place by the Birmingham Official Receiver, the petitioning creditor being Boughton & Company. The Official Receiver reported that the elder defendant had been guilty of fraud, and the investigation disclosed that the company owed £543 3s. 9d., in respect of which there was not a farthing assets, and there was no valuation of assets. The debenture holders, however, seized everything, and the whole of the concern was transferred to a new company, which was immediately incorporated. The solicitor for the company, since deceased, offered a composition of 6s., or 7s. 6d., which was the invariable practice. That offer was always accompanied by a veiled threat that if the composition was not accepted the company would be wound up, because the debenture holder would seize all the assets, and there would be nothing for the creditors. Usually the creditors were induced to accept the composition, but some of them went without payment altogether. During the investigation of the first company it was shown that no books were kept, and it was impossible to ascertain what trade had been done. During all those years creditors had been robbed, and he (counsel) could only express his astonishment that they did not take advantage of the Companies' Act, which would have given them protection. In 1912 Messrs. Bond & Company, of Nottingham, who were dissatisfied creditors, took action, which led to a compulsory winding-up, and it was then shown that the company then called H. C. Harvey, Limited, had existed only five months, and that its creators were the Harvey family. Counsel proceeded to give details of the form of debenture adopted, in which there was a clause, "Provided always in case of any hostile action being taken against the company" the debenture holders could foreclose. That "hostile action," counsel pointed out, meant that if any creditor claimed payment of his debts the Harveys as debenture holders swooped down upon them like commercial hawks and seized everything. As a sample of the transactions the case of the Frodair Iron Company was mentioned. From that company four tons of pig-iron were ordered, and the company were imposed upon by the

fact that the note heading had the words "Established 1888." That was in 1912, and the 1888 company had long since been superseded by a number of others. The pig-iron then sent was really seized on a writ issued ten days before the order was placed. A peculiar feature was that the correspondence was invariably written by the Harveys, but at their residence a large quantity of blank notepaper was found which bore the signature of the solicitor. That was a device which obviously was intended to deceive the people with whom they corresponded. Among the transactions was a sale by Mr. Southgate, of Ipswich, who supplied 20 tons of pig-iron to the Aston Cross Company in 1905, and he never received a penny; Mr. Joseph Connolly, of Bridgnorth, who sold a truck load of scrap; Charles Thomas & Company, Llandillo,; and Richardson & Son, Newcastle-on-Tyne. The transaction with Grant Brothers related to 51 tons 12 cwts. of scrap metal, for which payment had not been received. The account originally was for £204, but owing to the complaints of the defendants it was reduced to £175, of which, however, they had not received any payment.

Evidence was given bearing out counsel's statements

A. P. Cox, from the office of the Registrar of Companies, formally proved the formation of the 29 companies. Replying to defending counsel, witness said all the companies were duly formed in accordance with the law. With regard to the sale of the Manchester syndicate from a London man named Martin, the business of selling companies was often done, although he did not think the Board of Trade approved of it.

O. Mutlow, whose name appeared in connection with one of the companies, Harvey, Mutlow & Company, Limited, said the two forms constituting the memorandum and articles of association of Harvey, Mutlow & Company, Limited, were blank when he signed them. He was not afterwards consulted about the formation of the company. He had never attended a meeting of the company, and denied that he had ever received £10 for the sale of shares.

J. T. Whitehouse, mining engineer, said he subscribed for ten shares in Harvey & Brooks, Limited. He wrote nothing on the sheet submitted but his name, address and description. His signature was accompanied by that of a witness, G. Harvey, but that was wrong, as no witness was present. Witness said he acted also for four other companies in the same way, two of them being Harvey & White, Limited, and Harvey & Whitehouse, Limited. In two of these he was stated to be the holder of £50, but in all he never subscribed more than £5. The papers of two of the companies were blank when he signed them.

R. R. Dale, solicitor, said he acted for certain of the companies after they were registered, but he had not authorised anyone to send out notices of seizure by debenture holders which bore his name at the bottom. He did not assent to the sending out of notices to creditors by the liquidator bearing his address.

The defendants were remanded until this month.

The New Parliament.

The following list of members includes some well known names in the iron and steel industries:—Battersea, North, Mr. Richard Morris, connected with a leading firm of engineers; Camberwell, North, Captain Newton Knights, an engineer; Hammersmith, South, Sir W. J. Bull, chairman of J. W. Singer & Sons, bronzefounders, of Frome and London; Hampstead, Mr. George Balfour, founder of the firm of Balfour, Beatty & Company. London: Mile End, Mr. W. P. Preston, a director of J. Stone & Company, Limited, engineers, Deptford; Birkenhead, West, Lieutenant-Colonel H. M. Grayson, head of H. & C. Grayson, Limited, shipbuilders; Moseley, Sir Hallewell Rogers, chairman of the Birmingham Small Arms Company; Leeds, Central, Mr. Robert Armitage, of the Farnley Iron Company, Limited; Manchester, Exchange, Sir John Randles, Workington Iron & Steel Company, Limited; Gorton, Mr. John Hodge, secretary of the Steel Smelters; Middlesbrough, Colonel Penry Williams, joint-managing director of the Linthorpe-Dinsdale Smelting Company, Limited; Sheffield, Ecclesall, Sir Samuel Roberts, of Cammell, Laird, & Company, Limited; Sheffield, Hallam, Mr. Douglas Vickers, of Vickers, Limited; Sheffield, Park, Lt-Col. H. K. Stevenson, of Stephenson, Blake & Company; Smethwick, Mr. J. E. Davison, official of the Ironfounders' Society; Worcester, Sir Edward Alfred Goulding, of the British Westinghouse Electric & Manufacturing Company, Limited; Glasgow, Shettlestone, Admiral Adair, head of the gun department of W. Beardmore & Company, Limited; Wansbeck, Mr. Robert Mason, of the Shields Engineering & Dry Docks Company; Keighley, Mr. Robert Clough, governing director of the Keighley Gas & Oil Engine Company, Limited; Dumbarton, Sir William Raeburn, of Bull's Metal & Melloid Company, Limited.

Applications for Patents.

The names of communicators are printed in Italic type. A new number will be given when the Complete Specification is accepted.

Bloxam, A. G. (*Stabilimenti Biak—Ing. A. Pouchain*). Metallurgical furnaces. 21,542. December 23.

Brayshaw Furnaces & Tools, Limited, and Brayshaw, S. N. Oil-fired furnaces, and injector or burner therefor. 21,701. December 30.

British Thomson-Houston Company (*General Electric Company*). Treatment of metals. 113. January 2.

British Thomson-Houston Company (*General Electric Company*). Metals and their manufacture. 212. January 3.

Coats, A. Continuous casting of rods, bars, etc. 20,060. Decemoer 4.

Coles, S. O. Cowper-. Process for manufacture of finely-divided metals. 18,486. November 12.

Fuller J. W., and Fuller Engineering Company. Steel-emelting furnaces. 278. January 4.

Gasche, F. G. Treating metal ingots, etc. 18968. November 19.

Griggs, J. O. Open-hearth furnaces. 21,550. December 23.

Grover, W., and Wigan, O. S. Aluminium alloys. 20,292. December 6.

Holslag, C. J. Metallic electrodes for electric arc welding operations. 20,640. December 11.

Holslag, C. J. Masks for welding operations. 20,641. December 11

Humfrey, J. C. W. Notched bar testing-machines. 19,363. November 25.

Harvey, L. C. Metal-melting furnace. 18,529. November 12.

Harvey, L. C. Feeders for pulverised fuel. 18,839. November 16.

McGahan F. L. Alloying-furnaces. 18,616. November 13.

McKechnie, Sir J. Moulding, etc., apparatus. 17,844. October 31.

Marks, E. C. R. (*American Manganese Steel Company*). Method of making manganese steel. 18,526. November 12.

Munden, R. A., and Shilton, W. A. Crucible furnaces. 19,810. November 30.

Moore, W. E. Electrical metallurgical furnaces. 20,378. December 7.

Player, E., and Sterling Metals, Limited. Crucible, etc., furnaces heated by gas or liquid fuel. 192. January 3.

Smeeting-Wright Furnaces, Limited. Gas-fired furnaces. 21184. December 18.

Soc. Anon. de Commentry Fourchambault & Decazeville. Alloy containing iron, nickel, chromium. 21068. December 17. (France, December 19, 1917.)

Soc Anon. de Commentry Fourchambault & Decazeville. Alloy containing iron, nickel, and chromium. 21070. molybdenum. 21069. December 17. (France, December 20, 1917.)

Soc. Anon. de Commentry Fourchambault & Decazeville. Alloy containing iron nickel, and chromium. 21070. December 17. (France, December 21, 1917.)

Soc. C. M. Stein et Cie. Charging of steel-melting, etc., furnaces. 21,794. December 30. (France, September 12.)

Stabilimenti Biak—Ing. A. Pouchain. Metallurgical furnaces. 21.542. December 23.

Thompson, R. W. Casting machines. 21,707. December 30.

Thompson, R. W . Casting machines. 21,753. December 30.

Walker, J. B Process for making metal castings and its product. 215. January 3.

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Type "A" Duplex Machine for Pneumatic Power.

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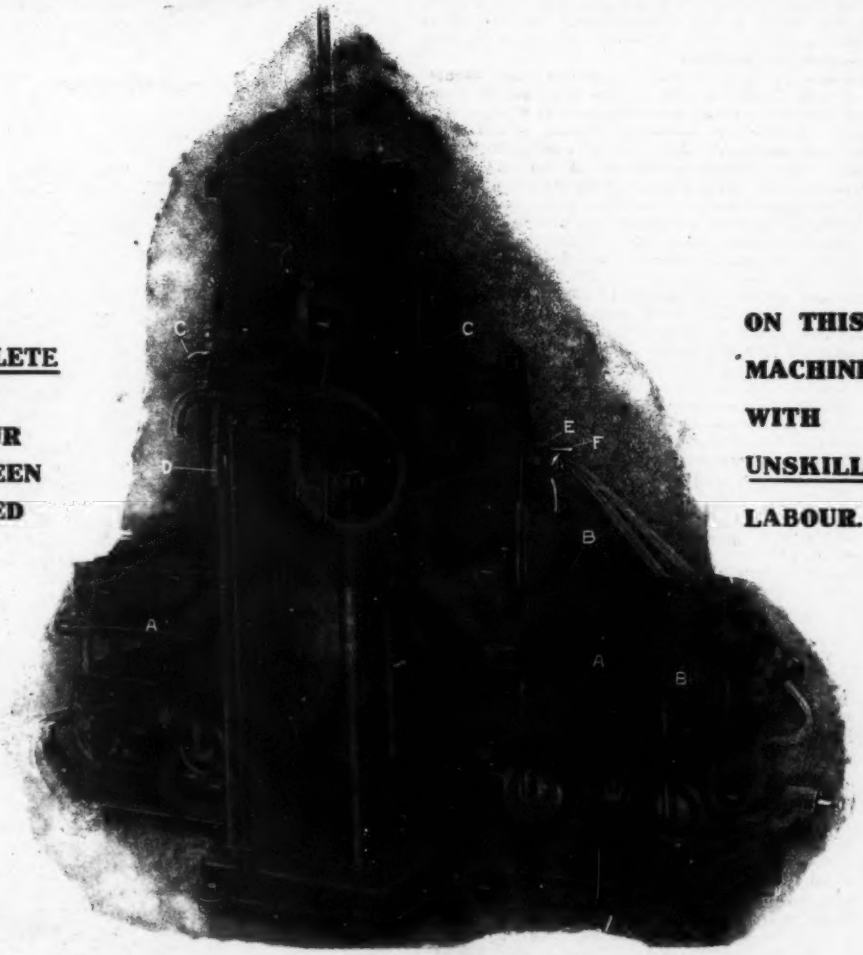

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New Companies.

Cricklewood Foundry, Limited.—Capital £2,000 in 5s. shares.

Haywood Foundries, Limited.—Capital £10,000 in £1 shares.

Universal Valve Company, Limited.—Capital £25,000 in £1 shares.

Bristol Foundry Company, Limited.—Capital £10,000 in £1 shares.

Transport Engineering Company, Limited.—Capital £10,000 in £1 shares.

John Thompson Motor Pressings, Limited.—Capital £100,000 in £1 shares.

"Lyons" Oxy-Acetylene Economiser, Limited.—Capital £5,000 in £1 shares.

Chester Engineering Company (1918), Limited.—Capital £30,000 in £1 shares.

Cambrian Welding & Engineering Company, Limited.—Capital £1,000 in £1 shares.

Cosmos Consolidated, Limited.—Capital £500,000 in £1 shares, to carry on the business of engineers.

Edward Rawlins & Son, Limited.—Capital £50,000 in £1 shares, to carry on the business of engineers.

New Industries, Limited.—Capital £5,000 in £1 shares, to carry on the business of engineers, etc.

Bradbury & Jarvis, Limited.—Capital £2,000 in £1 shares, to carry on the business of engineers, etc.

Chelsea Precision Tools, Limited.—Capital £5,000 in £1 shares. Registered offices: 4-5, Norfolk Street, W.C.

Bolling & Lowe, Limited.—Capital £25,000 in £1 shares. Registered office: 2, Laurence Pountney Hill, E.C.

Motor & General Engineers, Limited.—Capital £5,000 in £1 shares. Registered office: 26, Long Acre, W.C.2.

Duplex Engines, Limited. — Capital £5,000 in £1 shares. Registered office: 55, Bridge Street, Manchester.

John Thompson (Wolverhampton), Limited.—Capital £230,000 in £1 shares, to carry on the business of engineers.

British Spiro Turbine, Limited.—Capital £50,000 in £1 shares. Registered office: City Chambers, Infirmary Street, Leeds.

Central Engineering Works (Cardiff), Limited.—Capital £5,000 in £1 shares. Registered office: Bute Dock, Cardiff.

Fluxite, Limited.—Capital £25,000 in £1 shares. Registered office: Simplex Works, Bevington Street, Bermondsey, S.E.

Hamaide, Limited.—Capital £5,000 in £1 shares, to carry on the business of engineers. Registered office: Goodmayes, Essex.

Lanesfield Foundry Company, Limited. — Capital £20,000 in £1 shares. Registered office: 231, Elliot Street, Glasgow.

Westminster Metal Works, Limited.—Capital £10,000 in £1 shares. Registered office: 1-2, Old Pye Street, Westminster, S.W.1.

John Thompson (Dudley), Limited.—Capital £100,000 in £1 shares, to carry on the business of engineers, founders, smiths, etc.

Somerville-Barnard Construction Company, Limited.—Capital £10,000 in £1 shares. Registered office: 120, Victoria Street, S.W.

Ramsgate Garage & Engineering Company, Limited.—Capital £25,000 in £1 shares. Registered office: 36, Camomile Street, E.C.

Pearson & Ramage, Limited.—Capital £10,000 in £1 shares, to acquire and carry on the existing business of ironfounders, in Alloa.

British "Air" Brake Company, Limited.—Capital £50,000 in £1 shares. Registered office: 15, Dean's Yard, Westminster, S.W.

Slogger Engineering Company, Limited.—Capital £50,000 in £1 shares (40,000 preference). Registered office: 122, Cannon Street, E.C.

High Temperature Generators (1918), Limited.—Capital £150,000 in £1 shares. The first directors are S. Wickens and W. H. Manning.

Jigs, Limited.—Capital £5,000 in £1 shares. The first directors are H. M. Small and G. Keys. Registered office: 3, Berners Street, W.

O. & S. Oilless Bearing Company, Limited.—Capital £5,000 in £1 shares. Registered office:—18, Polland Street, Gt. Marlborough Street, W.1.

The Tool Union, Limited.—Capital £5,000 in £1 shares. The first directors are W. R. Paige (Sheffield) and W. J. A. Perkins (Northwood).

George Slade & Company, Limited.—Capital £10,000 in £1 shares, to carry on the business of engineers. Registered office: 3 Barnsbury Park, N.

Frank Waring, Limited.—Capital £5,000 in £1 shares, to carry on the business of engineers, etc. The first directors are J. Chilton and F. Waring.

Arthur Firth, Limited.—Capital £5,000 in £1 shares, to carry on the business of engineers. Registered office, Atlas Works, South Parade, Cleckeaton.

James Macallan & Company, Limited.—Capital £5,000 in £1 shares, to carry on the business of engineers. Registered office: Broad Street House, E.C.

E. Coates & Company, Limited.—Capital £10,000 in £1 shares, to carry on the business of ironfounders. Registered office: Craven House, Kingsway, W.C.

"C" Metals, Limited.—Capital £30,000 in 8,000 ten per cent. cum. part. pref. shares of £1 and 440,000 ordy. of 1s. Registered office: 8, Queen Street, E.C.

Turquand & Rew, Limited.—Capital £10,000 in £1 shares, to carry on the business of engineers. Registered office: Albion House, 59-61, New Oxford Street, W.C.1.

Manufacturing Engineers, Limited.—Capital £2,000 in £1 shares. Permanent directors, E. P. Barnfield and S. W. Wilkins. Registered office: 283, Grays Inn Road, W.C.

North-Western Shipbuilding Syndicate, Limited.—Capital £10,000 in 9,500 preference shares of £1 and 10,000 deferred of 1s. Registered office: 31, Lombard Street, E.C.

New Trafford Engineering Company, Limited.—Capital £32,000 in 1,200 Pref. shares of £25, and 2,000 Ord. of £1. Registered office: 55, Shaftesbury Avenue, W.1.

Cardiff Docks Engineering Works, Limited.—Capital £3,000 in 1 shares, to acquire the business of J. H. Korner & Grivas, at Harrowby Street, Cardiff, and adjoining works.

Aberdeen Ship Repairing Company, Limited.—Capital £6,000 in 4,250 preferred shares and 1,750 ordinary shares of £1 each. Registered office: 220, Union Street, Aberdeen.

G.L. Manufacturing Company, Limited.—Capital £10,000 in £1 shares, to carry on business as mechanical engineers, etc. The first directors are F. Pollard and J. Lambert.

Brett & Watson, Limited.—Capital £1,000 in £1 shares, to acquire the business of pattern-makers carried on by Brett & Watson. Registered offices: 555, Govan Road, Glasgow.

Boucher Brothers, Limited.—Capital £6,000 in 5,000 preference shares of £1, and 20,000 founders' of 1s., to carry on the business of engineers. Registered office: 16, Regent Street, S.W.

Stockport Engineering Company, Limited.—Capital £5,000 in 4,000 preference, and 1,000 ordinary of £1 each. Registered office: Swallow Street, High Hillgate, Stockport, Cheshire.

John Mitchell & Company (Halifax), Limited.—Capital £5,000 in £1 shares, to carry on the business of engineers' tool makers. Registered office: Godley Ironworks, New Bank, Halifax

British Needle Company, Limited.—Capital £20,000 in £1 shares, to acquire the business of the S.P.A.R. Manufacturing Company, Limited, and the shares in B. Hampton, Sons & Company, Limited.

Carrick Foundry, Limited.—Capital £20,000 in £1

WILLIAM JACKS & COMPANY,

LONDON AND BIRMINGHAM.

Telegrams: ALKALIZE, LONDON.
Telephone: 7800 AVENUE (3 lines.)
Head Office:
5, EAST INDIA AVENUE, LONDON, E.C.

Telegrams: ALKALIZE, BIRMINGHAM.
Telephone: CENTRAL 1175 & 1176.
Birmingham Office:
18, BENNETTS HILL.

LIVERPOOL: 11, Oldhall Street. Telegrams: LATEM, LIVERPOOL. Telephone: Central 6704.

PIG IRON.

Scotch, Middlesbro', Hematite, Basic, Specials, &c., &c.

STEEL.

Billets, Wire Rods, Tube Strip, &c.

REGISTERED TRADE MARK

COPPER.

Tough, Best Selected and Refined Ingots, Electrolytic Ingot Bars, Wire Bars, and Cathodes.

TIN.

All Brands Ingot and Bar Tin.

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G.O.B.'s and Special Purities.

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ROYAL EXCHANGE, MIDDLESBRO'.

Telegrams: COLVIN, GLASGOW.
Telephone: CENTRAL 7460.
93, HOPE STREET, GLASGOW.

WILLIAM COLVIN & COMPANY,

MIDDLESBOROUGH AND GLASGOW.

shares. The first directors are F. Allen, G. Barrett, V. Calverley, R. Carrick, W. J. Hinde, and R. A. Vinter. Registered office: Bradford Road, Keighley.

Liverpool Copper Wharf Company, Limited.—Capital £2,500 in £1 shares, to take over the business of James Lewis & Son's Copper Wharf Company, Limited. The first directors are A. H. Lewis, G. D. Lewis, and J. A. Wilson. Registered office: 5, Fenwick Street, Liverpool.

Buyers of Scrap Metal, Limited.—Capital £50,000 in £1 shares. The first directors are D. H. Barnard, 6, Queen's Gardens, Hyde Park, W., metal merchant; J. H. Barnard, Stonehouse, Reigate, metal merchant; sole selling agents, H. B. Barnard & Sons. Registered office: Glynn Street, Vauxhall, S.E.

Sheffield Steel Products, Limited.—Capital £1,000,000 in £1 shares, to take over the businesses of Carr, Wild & Company, Limited, Boswell, Hatfield & Company, Limited, E. W. Cheesman & Company, Sheffield Steel Products, Arnold & Son, and the Chaucer Plating Company. Registered office: New Enterprise Works, Egerton Street, Sheffield.

Llanwrst Foundry Motor Engineering Company, Limited.—Capital £2,000 in £1 shares (500 6½ per cent. cumulative preference), to take over the business carried on by W. R. Thomas at the Foundry, Denbigh Street, Llanwrst. The first directors are R. Henschell and J. A. McNaughton. Registered office: 9, Denbigh Street, Llanwrst, Denbigh.

Ewart Chain Belt Company, Limited.—Capital £200,000 in £10 shares, 3,000 preference, to take over the business of Ewarts' Chain Manufacturing Company and the Chainbelt Engineering Company, both carried on by Sir Hy. Gordon Ley, and to adopt an agreement with Sir Hy. Gordon Ley and Ley's Malleable Castings Company, Limited. First directors, Major Sir Henry Gordon Ley, H. M. Gray, E. N. Wood, W. H. Atherton, and I. F. Panton. Secretary, I. F. Panton.

"Where Capital and Labour Meet"

at the Employment Exchange

In the case of both Master and Man—the road to mutual satisfaction is the Employment Exchange. There is an Employment Exchange for every important district in the country, supervised by a joint committee of employers and workpeople.

Both Employers and Men are urged to realise—

1. That the nearest Employment Exchange is the nearest way to a good job for a man.
2. It is the nearest way to getting a good workman that any employer can take.
3. The Employment Exchange can supply the employer with a man who has fought for him. It is only fair that he should be given the chance to work for you. He helped to forge victory. His now the just claim to enjoy its fruits.

The Employment Exchange is the common meeting ground for master and man. The Government bring the twain together.

If you want a good man—if you want a good job—go to your nearest Employment Exchange and get one!

DIE-CASTING MACHINE AND WHITE METALLING PLANTS

For all Soft Metals, Aluminium Alloys, &c.

CONSISTING OF THE

MONOMETER DIE CASTING MACHINE,
WHITE METAL MELTING FURNACE,
MOULD AND BEARING HEATING OVEN,
——— and TINNING FURNACE.———

We are also Makers of Crucible and Non-Crucible Furnaces in capacities from 30 to 1,000 lbs., and from 1,000 lbs. to 10,000 lbs., for all Ferrous and Non-Ferrous Metals, Steel, Malleable Iron, &c.

THESE PLANTS ARE BEING EXHIBITED DURING DEC. 27 TO JAN. 9 AT THE EXHIBITION OF BRITISH SCIENCE PRODUCTS, MANCHESTER

Sole Makers:—THE MONOMETER MANUFACTURING CO., Ltd., ASTON, BIRMINGHAM.

GANISTER, CUPOLA BLOCKS, FIRE BRICKS,

FIRE CLAY.

Silica Bricks, Tuyeres, Stoppers, Nozzles, &c.

STEEL MOULDERS' COMPOSITION, SILICA CEMENT.

J. GRAYSON LOWOOD & Co., Ltd.,

DEEPCAR nr. SHEFFIELD.

Telegrams: "LOWOOD, DEEPCAR."

GOLDENDALE CYLINDER PIG IRON.

MAKERS:

GOLDENDALE IRON CO.,

STOKE-ON-TRENT.

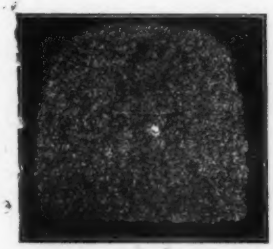
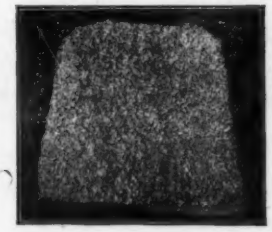
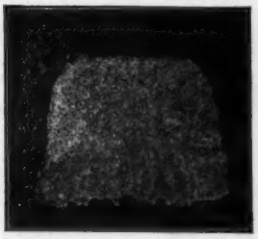
NOTE THE FOLLOWING POINTS—

1. Dense with close grey fracture.
2. Melts hot and exceedingly fluid and will fill every corner of your Mould.
3. Easy to Machine.
4. Absolutely sound.

WE MAKE A SPECIAL QUALITY FOR

MOTOR CYLINDERS.

Contractors to the Admiralty, Principal Railway Companies and Engineers at Home and Abroad.

Selling Agents: WESTOBY & RAWSTRON,

224, Corn Exchange Buildings, Hanging Ditch, MANCHESTER.

Personal.

MR. G. F. S. EDWARDS has resigned his position as Director of Ship Repairs.

MR. W. MUIRHEAD has retired from the presidency of the Central Ironmoulders' Association.

THE late Mr. Simon Tate, a director of Walter Scott, Limited, left estate valued at £57,129 gross.

PROF. PERCY FRANKLAND is resigning the Mason Chair of Chemistry in the University of Birmingham.

THE late Mr. J. F. G. Parsons, a director of C. A. Parsons & Company, Limited, left estate valued at £11,418.

THE late Mr. J. A. Duncan, chairman of the Coltness Iron Company, Limited, left personal estate valued at £73,568.

MR. ANDREW WEIR, on elevation to the Peerage, has chosen the title of Baron Inverforth, of Southgate, in the County of Middlesex.

M. MORELLE has recently been appointed Professor of General Metallurgy and Siderurgy at the Ecole Superieure des Mines, Paris.

MR. ROLAND WOODS, of the Board of Trade, has been appointed secretary of the British Federation of Iron and Steel Manufacturers.

MR. J. F. ROBINSON, a director of the North British Locomotive Company, Limited, who died on July 12, left estate of the value of £128,494.

MR. E. TATE, of Messrs. E. Tate & Company, iron and steel merchants, etc., of King's Chambers, Market Place, Sheffield, retired from business at the close of the year.

MR. C. F. L. MACE has been elected managing director of Hall & Pickles, Limited, of Manchester. Mr. Mace was formerly in charge of the company's Birmingham office.

MAJOR D. MYLES has retired from the general managership of the Wallsend works of the North-Eastern Marine Engineering Company, Limited, after 28 years' service with the firm.

MR. R. W. HUNT, the veteran American steel works engineer, of Robert W. Hunt & Company, was the recipient of many honours on the occasion of his eightieth birthday anniversary on December 9.

MR. J. F. PEACE, manager of the goods department of Thos. Firth & Sons, Limited, Sheffield, has been the recipient of a presentation on the occasion of his retirement after 47 years' service with the firm.

THE Institution of Civil Engineers have elected to their roll of distinguished honorary members Marshal Foch, O.M., Field-Marshal Sir Douglas Haig, K.T., and Admiral Viscount Jellicoe of Scapa, G.C.B., O.M.

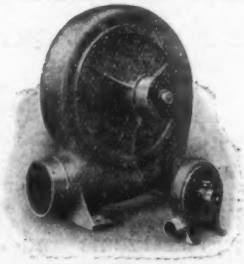
SANKEY

Pressed Steel Foundry Ladles

Plain or Lipped.

JOSEPH SANKEY & SONS, LD., WELLINGTON, SHROPSHIRE.

Dust Fan.



High Pressure Fans.

Volumetric Fan.

Fans for Ventilation, for Dust Removal, for Induced & Forced Draft on Boilers.

TRADE SIROCCO MARK

FANS

Cupola and Forge Fire Fans for large or small duties. Reliable and efficient.

Davidson & Co., Limited.,

Sirocco Engineering Works.

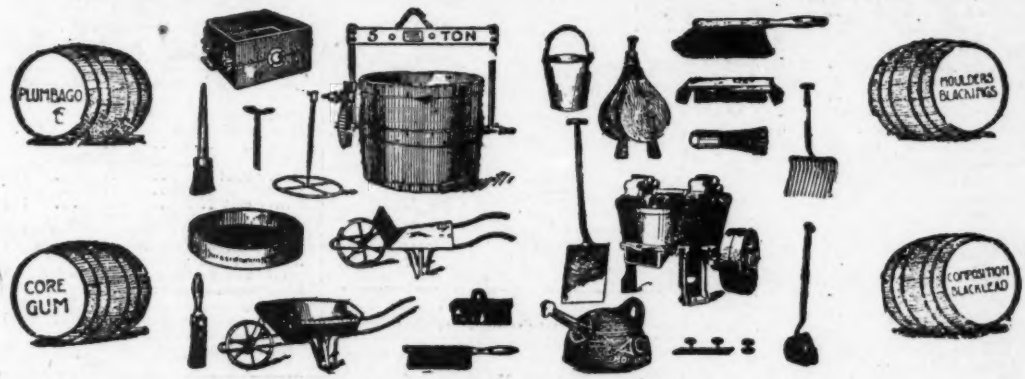
BELFAST.

Telegrams: "Durrans, Pennistone." Telephone: 21, Pennistone.

Established 1863.

JAS. DURRANS & SONS,

Phœnix Works, Penistone, Near Sheffield.



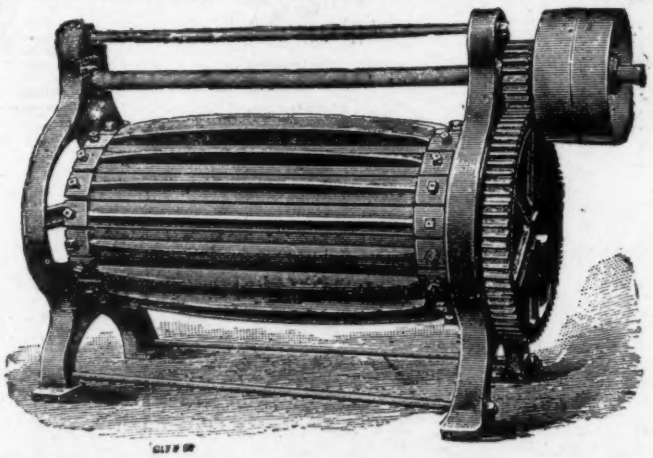
Manufacturers of all

FOUNDRY EQUIPMENTS

COMPOSITION BLACK LEAD, PLUMBAGO, CORE GUM, WHITE DUST & COAL DUST

Ladles, Cupolas, Fire Bricks, Gannister, Stone Flux, Loam and Sand Mills, Casting Cleaners, Studs, Chaplets, Pipe Nails, Sprigs, Brushes, Wire Brushes, Core Ropes, Bellows, Buckets, Spades, Forks, Riddles, Sieves, Barrows, Etc.

Improved Foundry Rattler or Fettling Drum.



These Machines are invaluable for a Foundry, doing a larger amount of work of a superior quality, in a much shorter time than can be done by hand, without skilled labour.

The following testimonial explains itself :—

"Dear Sirs,—We have been using your best Blacking for a large number of years, and always use it on our large Ingot Moulds, which, as you know, we have made up to 85 tons in weight.

Yours faithfully, THE BRIGHTSIDE FOUNDRY & ENGINEERING CO., LD.

MONTHLY PRICE LIST.

The undermentioned prices, unless otherwise specified, are those obtaining at the commencement of the current month.

CONTROL PRICES.

Pig-Iron.

	£	s.	d.
West Coast hematite, mixed Nos. 1, 2 and 3	6	7	6
Special under 0.03 P. & S.	6	15	6
„ „ 0.02 „	7	0	0
East Coast hematite, mixed Nos. 1, 2 and 3	6	2	6
Special under 0.04 P. & S.	6	7	6
Special under 0.03 P & S.	6	15	6
„ „ 0.02 „	7	0	0
Scotch hematite, mixed Nos. 1, 2 and 3	6	2	6
Special under 0.03 P. & S.	7	10	0
Welsh hematite, mixed Nos. 1, 2 and 3	6	2	6
Special under 0.03 P. & S.	6	15	6
„ „ 0.02 „	7	0	0
HEMATITE—MALLEABLE— Refined—			
Refined Cupola Cast	8	0	0
Refined Cupola Cast to guaranteed analysis	8	5	0
Cast direct from Blast Furnaces—			
Small Pig-Iron, all grades	7	10	0
Medium Pig-Iron White to Grey mottled	7	5	0
Medium Pig-Iron, all other qualities	6	17	6
Large Pig-Iron, all grades	6	17	6
Lincolnshire, basic or foundry	4	17	6
Cleveland, No. 1	4	19	0
„ other grades	4	15	0
„ basic	5	0	0
Northamptonshire, forge	4	7	6
„ fdy numbers	89/0		94/0
„ basic	4	17	6
Derbyshire, forge	4	10	0
„ foundry numbers	92/6		96/6
Derby & Notts. basic.	4	17	6
Leicestershire & Notts., forge	4	10	0
„ „ foundry nos.	92/6		96/6
North Staffs, forge	4	15	0
„ „ foundry	4	17	6
„ „ basic	4	17	6
South Staffordshire—			
Part mine forge	5	0	0
„ foundry	5	2	6
Common Staffordshire	4	15	0
All mine forge	5	15	0
„ foundry	6	0	0
Warm air forge	7	5	0
„ foundry	7	15	0
Lord Dudley's silicon	8	7	6
Cold blast	9	2	6
Basic	4	17	6
Scoten foundry and forge—			
Nos 3, 4, and lower grades of Monkland, Dalmellington, Eglinton, and Govan	5	14	0
Nos. 3, 4, and lower grades of all other brands	5	15	6

No. 1 quality in all cases to be 5s. per ton above these prices.

All per ton net. f.o.t. makers' works Mers Com 1¼%

In all districts 1s. extra may be charged for Basic cast in chills.

High-Speed Tool Steel.

The maximum prices for high-speed tool steel have been fixed as follows :—

Finished bars, 14% Tung. 3s. 8d.

Finished bars, 18% Tung. 4s. 5d.

Per lb. basis. Extras as per authorised list. These prices are net delivered buyers' works.

The fixed prices for scrap which must be returned to steel makers' works are as follows :—

Millings and Turnings .. .. 8d.

Bar Ends .. .. 9d.

Both per lb. net delivered steel makers' works

Ferro-Alloys

Net, Delivered Sheffield steel works.

	£	s.	d.
Ferro chrome : 4/6% carbon. Basis 60%, scale 10s. per unit Per ton	—		
Ferro-chrome : 6/8% carbon. Basis 60%, scale 10s. per unit. Per ton	—		
Ferro-chrome : 8/10% carbon. Basis 60% scale, 10s. per unit Per ton	—		
Ferro-chrome : Specially refined, guaranteed maximum 2% carbon broken to small pieces for use in best quality crucible steels. Basis 60%, scale 32s. per unit. Per ton	—		
Ferro-vanadium : 33/40% Va., per lb. of Va contained in the alloy	—		
Ferro-silicon : 45/50%. Basis 50%, 5s. scale per unit .. Per ton	—		
Ferro-titanium : 23/25%, per lb. carbonless	—		
Ferro-molybdenum : 70/80% Mo. per pound of Mo. contained	—		
Ferro-phosphorus : 20/25%. Per ton	—		
Ferro-tungsten : 75% to 80% per lb. of metallic tungsten contained	—		
*Ferro-manganese 80%	26	10	0
„ export	—		

* F.o b. Liverpool.

Non-Ferrous Metals.

	£	s.	d.	£	s.	d.
Copper.						
Standard, Cash	77	0	0	78	0	0
Three months	73	10	0	74	0	0
Electrolytic	100	0	0	90	0	0
Tough	90	0	0	103	0	0
Best selected	90	0	0	103	0	0
Tin.						
Standard, Cash	224	10	0	225	0	0
„ Three months	223	0	0	223	10	0
English Ingots	223	10	0	—		
Bars	224	10	0	—		
Refined	—			—		
Spelter.						
Ordinary	50	0	0	—		
Specials	—			—		
Hard	33	0	0			0
British	—			—		
Lead.						
Soft Foreign (net)	30	0	0	—		
English	—			Nom.		
Antimony.						
Regulus	—			45	0	0
Aluminium.						
Virgin Metal 98/99% per ton	—			—		

Phosphor Bronze.

Ingots.	Per ton
Alloy No. I. or II	—
III., IV or V.	—
VI or VII.	—
VIII	—
XI	—
Cast Strips and Ingots	—

Castings.	Per lb.
I. or II	—
III. IV or V.	—
VI. or VII	—
VIII	—
XI	—
No. VII., Chill, Cast, Solid Cored Bars	—

Delivery 2 Cwt free to any town.

10 per cent. Phosphor Copper .. £50 above price of best selected copper.

15 per cent. Phosphor Copper .. £70 above price B S

Phosphor Tin (5 per cent.) .. £30 above price of English Ingots.

(Phosphor-bronze prices supplied by CHARLES CLIFFORD AND SON, LIMITED, FAZELEY STREET MILLS, BIRMINGHAM).

'Chromium (Metallic).

98/99% purity, per lb. — —

'Nickel.

In cubes, 98/99% purity Per ton —

Nickel Silver. per lb

Ingots for raising — —

Ingots for Spoons and Forks — —

„ rolled to spoon size — —

'Tungsten Metal Powder.

96/98% purity .. per lb. — —

'Molybdenum Metal.

96/98% purity .. per lb. — —

'Cobalt Metal.

97% purity .. per lb. — —

Quicksilver.

75 lb. bottle — —

* Net, Delivered Sheffield Works.

Scrap Iron and Steel.

	£	s.	d.	£	s.	d.
Cleveland.						
Steel scrap, heavy melting	—			—		
Iron scrap cast (cupola metal)	—			—		
London (f.o.b.).						
Heavy steel				104	6	
Light				55	0	
Heavy cast				110	0	
Control Prices.						
Heavy Steel Melting Scrap	105	0		125	0	
Steel Planings, Turnings and Borings				65	0	
Steel Planings, Turnings and Borings mixed with Wrought Iron, &c.				50	0	
Steel Scrap, all other Classes				95	0	
Wrought Iron Scrap				125	0	
Ditto, mixed with Steel				95	0	
W.I. Planings, Turnings and Borings mixed with Steel, &c.				50	0	

Per ton delivered Buyers' Works.

Cast-Iron Scrap.

	£	s.	d.
Hy. ord. brkn., between 1½ cwt. and 10 cwt.	4	15	0
Hy. machy., brkn., bet. 1½ cwt. and 10 cwt.	5	0	0
Cold blast, brkn., bet. 1½ cwt. and 10 cwt.	6	15	0
Ingot mould, unbroken	6	0	0
Ditto, brkn., bet. 5 cwt. and 2 tons	6	5	0
Ditto, between 1½ cwt. and 5 cwt.	6	10	0
Extra for breaking into pieces not exceeding 1½ cwt.	0	5	0
Railway chairs for re-melting	5	0	0
Heavy lumps, not above 2 tons	4	12	6
Light	4	5	0
Burnt, broken, ready for cupola	3	0	0
Burnt fire bars	4	0	0
Turnings and borings for iron and steel makers	3	5	0

Per ton f.o.r. or f.l.b. Scrap merchants' commission, 2½ per cent.; additional 10s. allowed, except for railway chairs and turnings and borings, to cover inwards carriage and handlings on sales from scrap yards.

Coke.

	s.	d.	s.	d.
Middlesbrough.				
Gas Coke	—		55	0
Foundry	65	0	70	0
Glasgow.				
Foundry Coke	—		47	
Furnace Coke	37	0	—	
London.				
Welsh or Durham Foundry, d/d London Stations in truck	45	0	53	
Ditto, d/d Birmingham Statns.	44	0	48	
Yorkshire, d/d London Stations, in truck	42	6	—	
Ditto, d/d Birmingham Statns.	39	6	—	

CONTROL PRICES OF COKE.

	s.	d.
Scottish blast furnace	35	0
„ foundry	45	0
Durham & Northumbd. blast furnace	33	0
„ foundry	38	0
Yorkshire, Lancashire, Staffordshire, Notts., Derbyshire, Lincs, & Midland Counties blast furnace	32	0
Ditto. foundry	45	0
Ditto. steel melting (Sheffield Dist.)	54	0
South Wales blast furnace	37	6
„ foundry	50	6
All per ton net. f.o.t. ovens.		
Cumberland blast furnace	37	9
d/d West Coast furnaces		

SITUATIONS VACANT AND WANTED.

PRACTICAL FOREMAN MOULDER, open for suitable change. Grey Iron or Brass, up to 2 tons. Hand or machine.—Full particulars, apply Box 158, Offices of the FOUNDRY TRADE JOURNAL, 165, Strand, London, W.C.2.

FOUNDRY FOREMAN desires situation, used to high-class work in dry and green sand, and able to keep down costs.—Box 160, Offices of the FOUNDRY TRADE JOURNAL, 165, Strand, London, W.C.2.

FOUNDRY FOREMAN (34), in control of large iron-foundry, desires favourable change. A thorough practical and technical knowledge of Metallurgy, Iron-founding in all its branches, including Malleable Iron; also experience in Non-Ferrous practice; excellent training in the use of various Moulding Machines, etc.; 20 years in high-class work, jobbing, and repetition.—Address, Box No. 162, Offices of the FOUNDRY TRADE JOURNAL, 165, Strand, London, W.C.2.

ASSISTANT WORKS MANAGER required for Malleable Iron Foundry, must have had practical experience and control of up-to-date Malleable Foundry, and economical production of high-grade repetition work to Government requirements. A permanent position is assured, and a good salary will be paid to suitable applicant possessing necessary qualifications. No foreman need apply.—Applications should be addressed to The Chairman, Andrew Handyside & Company, Britannia Iron Works, Derby.

BOX No. 143.—Beg to thank all applicants for Foundry Foreman, and the above post will be settled by the end of the present month.

FOR SALE AND WANTED.

BRASS FOUNDRY for Sale as going concern, Manchester; offices, etc., room for extension.—Apply, Box 152, Offices of THE FOUNDRY TRADE JOURNAL, 165, Strand, London, W.C.2.

LABORATORY EQUIPMENT.—Complete contents of iron works laboratory for sale, comprising pure acids and reagents; chemical apparatus, etc. Further particulars on application.—Box No. 154, Offices of the FOUNDRY TRADE JOURNAL, 165, Strand, London, W.C.2.

WANTED, second-hand M.R.V. Morgan or Wright 200-300-lb. (brass) crucible, tilting furnace. Coke or gas fired. If possible with blower attachment. — Write with full particulars to Box No. 156, Offices of the FOUNDRY TRADE JOURNAL. 165, Strand, London, W.C.2.

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WIDNES.

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BRITISH PATENT No. 108,426, of 1916, relates to a drop flask Moulding Machine, whereby the system of moulding is rapid, accurate and inexpensive. Sale or licence.—TURNER, 28, Plumper's Road, Sheffield.

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1. New Foundry Cupola, Whiting type, by Jackman's, 3 to 5 tons per hour capacity.
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All in good condition, only having worked six months. Can be inspected at our works.

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FOUNDRY PLANT FOR SALE AT GEO. MANN & COMPANY, LTD., ARCHFIELD WORKS, LEEDS.

One Small Double Grinder, wheels 10 in. dia. by 1 in. face, new March, 1917. Offers.
Two Git Cutters for ¾ in. git, 9 in. stroke, by Roberts Bros., new 1917; £65 each.
One Sand Riddler, 18 in. dia. riddle, by Evans & Co., Manchester, new March, 1918; £25.
One Sand Mill, pan 3 ft. 10 in. dia., 12 in. deep, by Evans, new March, 1918; £39 15s.
One Rotary Magnetting Machine, Standard, by Rapid Magnetting Machine Co.; practically unused; £90.
One Magnetting Machine, B.B. type, Jogger, by Rapid Magnetting Machine Co.; practically unused; £110.
Two Dynamos for above, 100 volts, 10 amps, by Rapid Magnetting Machine Co.; new November, 1917; £21 each.
One 5-ton Weighbridge, by Denison. Offers.
One Core Oven, Millet type, for coal or coke, by Jackman; new September, 1917; £32.
One Core Oven, Hilgrif type, for coal or coke, by Jackman; new January, 1918; £36 8s.
Four Gas Tilting Furnaces, 600 lbs. pots, by Wrights; new January, 1917; £166 each.
Four Jarr Ram Moulding Machines, No. "0" size, by Britannia Foundry Co.; new October, 1918, £60 each.
One Jarr Ram Moulding Machine, No. 1 size, by Britannia Foundry Co.; new 1917; £78.
One Coke Slow Combustion Stove; new December, 1917 Offers.
One Dey Time Clock (100 numbers); new 1917. Offers.
One Power Sand Grinding Machine, by Britannia Foundry Co.; new May, 1916; £60 10s.
One Power Sand Riddler, 18 in. dia., by Jackman; new April, 1918, £23 10s.
One Hand Single Core Making Machine, up to 2¼ cores, by Evans & Co.; new July, 1916; £16 10s.
One Two-Spindle Emery Machine, two wheels 14 in. dia. by 2 in. face; new November, 1915; £10.
One Coke Breaking Machine, by Evans; new November, 1916, £30.
Two Core Ovens, for gas firing, by Jackman; new May, 1918; £44 16s. each.
One Avery's Platform Weighing Machine, to 3 cwts.; new 1918. Offers.
Moulding Boxes as follows:—191 pairs of Moulding Boxes, 9 in. by 9 in. by 5 in.; 60 ditto, 9 in. by 9 in. by 6½in.; 12 ditto, 9 in. by 9 in. by 8 in.; 72 ditto, 9 in. by 11 in. by 5½ in.; 73 ditto, 15 in. by 12½ in. by 7½ in.; 16 ditto, 11½ in. by 11½ in. by 7in.; 14 ditto, 12½ in. by 12½ in. by 7 in.; 70 ditto, 12½ in. by 9½ in. by 5 in.; 30 ditto, 11½ in. by 11½ in. by 8 in.; 47 pairs of Moulding Machine Boxes, 11 in. by 14 in. by 8 in.

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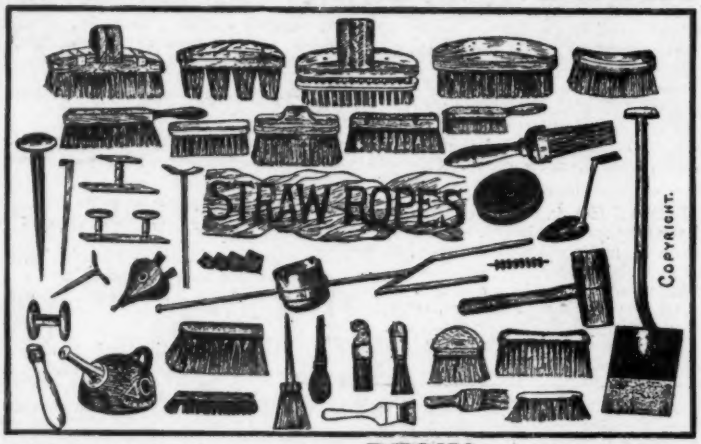

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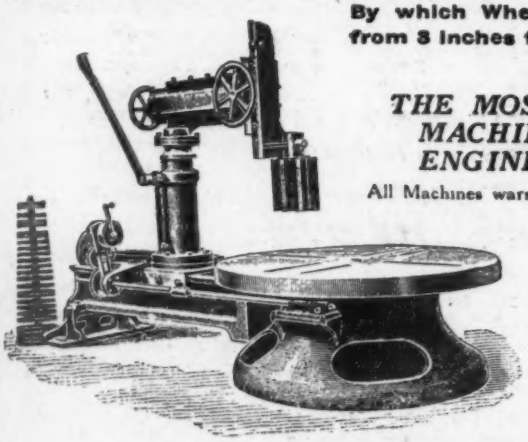

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